JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

BASIC DESIGN STUDY REPORT

ON

THE PROJECT FOR RETRIEVAL OF

FLOOD-PRONE AREAS IN METRO MANILA

(PHASE 2)

IN

THE REPUBLIC OF THE PHILIPPINES

JANUARY 1993

CTI ENGINEERING CO., LTD.

JICA
REPUBLIC OF THE PHILIPPINES
BASIC DESIGN STUDY REPORT ON THE PROJECT FOR RETRIEVAL OF FLOOD-PRONE AREAS IN METRO MANILA (PHASE 2)

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P R E F A C E

In response to a request of the Government of the Republic of the Philippines, the Government of Japan has decided to conduct the Basic Design Study on the Project for Retrieval of Flood Prone Areas in Metro Manila (Phase 2) and entrusted the study to the Japan International Cooperation Agency (JICA). JICA organized a Study Team constituted by members of CTI Engineering Co., Ltd. from November 2, 1992 to January 20, 1993 and conducted the basic design study, and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of the Philippines for their close cooperation extended to the team.

January 1993

Kensuke Yanagiya

KENSUKE YANAGIYA
President
Japan International Cooperation Agency

20 January 1993

Mr. Kensuke Yanagiya
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

We are pleased to submit to you the Basic Design Study Report on the Project for Retrieval of Flood Prone Areas in Metro Manila (Phase 2) in the Republic of the Philippines.

The study was made by CTI Engineering Co., Ltd., based on a contract with JICA, from November 2, 1992 to January 20, 1993. Throughout the study, we have taken into full consideration of the present situation in the Republic of the Philippines, and have planned the most appropriate project in the scheme of Japan's grant aid.

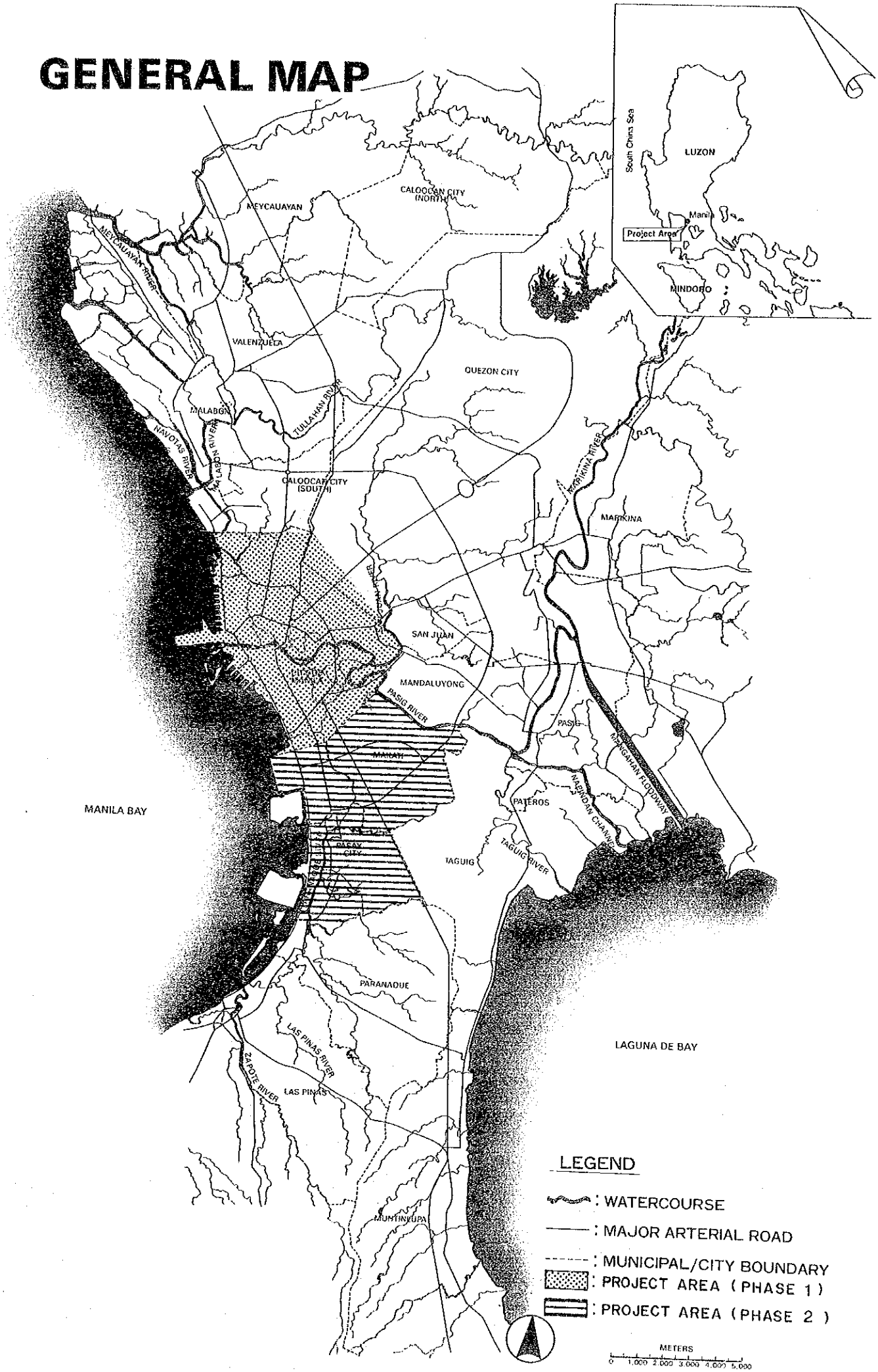
We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA and the Ministry of Foreign Affairs.

Lastly, we hope that this report will be effectively used for the promotion of the project.

Very truly yours,

MASAHIRO ASADA
Team Leader
Basic Design Study on the
Project for Retrieval of
Flood Prone Areas in Metro
Manila (Phase 2)
CTI Engineering Co., Ltd.

GENERAL MAP


South China Sea
LUZON
Manila
Project Area
MINDORO
CALOOCAN CITY (NORTH)
MEYCAUAYAN
MEYCAUAYAN RIVER
VALENZUELA
QUEZON CITY
MALABON
TULLAHAN RIVER
NAVOTAS RIVER
MA LABON RIVER
CALOOCAN CITY (SOUTH)
MARIKINA RIVER
MARIKINA
SAN JUAN
MANDALUYONG
PASIG RIVER
PASIG
MANILA
MANILA BAY
PATEROS
NAPINDAN CHANNEL
TAGUIG
TAGUIG RIVER
PARANAQUE
LAS PINAS RIVER
ZAPOTE RIVER
LAS PINAS
MUNTINLUPA
LAGUNA DE BAY
LEGEND
: WATERCOURSE
: MAJOR ARTERIAL ROAD
: MUNICIPAL/CITY BOUNDARY
: PROJECT AREA (PHASE 1)
: PROJECT AREA (PHASE 2)
METERS
0 1,000 2,000 3,000 4,000 5,000

S U M M A R Y

The Medium-Term Philippine Development Plan for 1987-1992 prepared by the Government of the Republic of the Philippines sets forth the development of the social infrastructure as one of its main goals. As a part of this work, emphasis is placed on the upgrading of flood control measures and, in particular, on the improvement of the existing drainage facilities in Metro Manila, as a speedy and effective means of reducing flood damage.

The master plan for flood control in Metro Manila was established in the 1950's, and flood control projects have been implemented since through external assistance including that from Japan. Flood damage, however, has been increasing in their severity with the progress of urbanization, seriously affecting the lives and economic activities of the over 8 million people living in Metro Manila. Much of this flood damage is attributable to the inadequate maintenance of the existing drainage channels, rendering them incapable of fulfilling their due functions for stormwater drainage.

Under the above circumstances, the Government of the Philippines has made a request to the Government of Japan for cooperation in conducting development studies for the planning of flood control measures appropriate for the actual conditions, and the "Study on Flood Control and Drainage in Metro Manila" was conducted by the Japan International Cooperation Agency (JICA) in 1988. In the same context, the Government of the Philippines planned as an emergency measure the implementation of improvement works on the existing drainage systems in and around the city of Manila over a period of 5 years and made a request to the Government of Japan for grant aid to procure the equipment required for the removal of sediments in the drains. The Government of Japan implemented a grant aid project in response to this request, which was completed in February 1991. As a marked reduction was observed in the flood damage as a result of this project, the Government of the Philippines adopted a plan for the improvement of the existing drains in a flood-prone area (approximately 60 km^2 covering Pasay City, Makati and a part of Parañaque) to the south of the area

covered in the previous project over a period of two and a half years as Phase 2 of the project and made a request to the Government of Japan for grant aid to procure the necessary equipment and to implement a model work (model implementation).

In response to this request, the Government of Japan decided to carry out a basic design study. The study team made an assessment of the characteristics of the project area through collection and analysis of information using the records of Phase 1 of the project as a basis, and conducted investigations on the contents, scale and appropriateness of the project, the results of which have been compiled in a report.

According to the basic design study, the existing drains requiring improvement can be classified into the small to medium-sized rivers ("esteros") used as the trunk drainage channels, large culverts ("drainage mains" and "outfalls") used as the main drainage pipes, and branch drainage pipes ("laterals"). The volumes of the sediments requiring removal on each of these categories are estimated as follows.

	Total Length (m)	Total Removal Volume (m^3)
Esteros	12.21	78,100
Drainage Mains/Outfalls	13.51	38,100
Laterals	96.14	18,900

The characteristics of the project area and the restrictions placed on the work are summarized below.

(1) Girder widths and clearances of bridges on the Parañaque River, classified as a large estero, are inadequate for the passage of dredging vessels underneath.

(2) Work using dredging vessels is practically impossible on the small esteros whose average width is only 5.0 m and onto which squatter housing protrude at many places.

(3) The waterjet cleaners used in the sediment removal on laterals consume large quantities of water. Equipment allowing reuse of the water would be more suitable in view of the serious water shortage in the project area.

(4) Since the project area has a relatively large traffic volume, considerations must be made to ensure that the cleaning of the drainage mains can be implemented safely and with the minimum amount of traffic control.

Comprehensive investigations were conducted, with the above points taken into account, on the characteristics of various equipment and the operational and management structure in the Government of the Philippines. The composition of principal equipment suited for use in the present project were determined, as follows.

	No. of Units	No. of Units Requested
(1) For Esteros		
(Large Estero)		
Clamshell Crawler with Pontoon Barge	1	1
Scow	2	2
Tugboat	1	1
Hydraulic Truck Crane	1	1
Dump Truck	3	3
(Small Estero)		
Clamshell Crawler with Pontoon Barge	-	3
Easy Setup Type Scow	-	6
Amphibious Soft Terrain Excavator	2	-
Amphibious Soft Terrain Carrier	4	-
Hydraulic Wheel Crane	2	3
Dump Truck	10	9

(2) For Drainage Mains and Outfalls

Hydraulic Wheel Crane	3	5
Dragline Equipment	6	-
Truck	6	-
Dump Truck	9	10

(3) For Laterals

Waterjet Cleaner	-	5
Water Recycle Vacuum Cleaner	2	-
Dehydration Vacuum Cleaner	-	5
Water Tanker	2	5
Dump Truck	8	10

Adequate experience has been gained on project supervision as well as on maintenance and operation of equipment through the model implementation in Phase 1. Since site conditions and restrictions in Phase 2 are different from those in Phase 1, and should the project be implemented by the grant aid, it is necessary to include in the project the transfer of technology required for the operation and maintenance to suit the particular conditions and working methods. For this reason, a work model will be performed in some selected areas as a project component in addition to equipment procurement.

The model implementation will involve the use of all the principal equipment to be procured under the grant aid and will be carried out by a Japanese contractor with ample experience of work similar to that in the Phase 2 project, under the supervision of a Japanese consultant. The total implementation period is estimated to be 6 months. The model areas are to be (1) the areas susceptible to floods, (2) the areas where it will be possible to confirm the effects of the model implementation and easy to obtain the evaluation of residents, and (3) the areas where it will be relatively easy to carry out traffic control during the model

implementation. Ten percent of the total work for the project will be executed during the model implementation period.

In the model implementation, technologies will be transferred to the staff of the National Capital Region (NCR), Department of Public Works and Highways, Government of the Philippines. The NCR, the official agency responsible for the supervision and implementation of the operation and maintenance of drainage systems in Metro Manila, will procure the staff, funds and special budgets required for the operation and maintenance of the equipment subsequent to the completion of the model implementation.

A period of approximately 12 months will be required for the project. The costs of the equipment procurement and model implementation are estimated to be approximately 1,255 million yen (to be borne under grant aid by the Government of Japan), while the costs to be borne by the Government of the Philippines are estimated at 7.5 million pesos (approximately 37 million yen). The operation and maintenance costs required for the sediment removal work on the drains to be implemented by the Government of the Philippines after the completion of the model implementation are estimated to be approximately 67.3 million pesos (336 million yen).

The details of the impact upon completion of the project and improvement of the existing drainage systems are as follows:

(1) Upon completion of the improvement work on the existing drains, the stormwater drainage capacity of the project area will be restored to a level adequate for the prevention of inundation in the event of a 10-year probability rainfall. The inundation damage to approximately 600,000 houses including those in areas adjacent to the project area will be reduced and the population benefiting directly from the project is estimated to be 3.3 million. When the reduction of the damage in the form, for example, of the disruption of the transportation network is also taken into account, the annual average reduction in the damage is estimated to be 280 million pesos.

(2) The following improvements are expected in the urban environment in the project area.

(a) The improvement of the drains will reduce the damage to houses and public facilities, minimize the loss of public and private properties, and contribute greatly to the improvement of standards of living and stabilization of the people's livelihood.

(b) The serious traffic congestion resulting from long-term stormwater inundation will be reduced, leading to the revival of economic activities.

(c) Dredging and unclogging of the existing drains will result in the removal of foul odor and causes of epidemics, leading to the improvement of sanitary conditions for the residents.

The project, besides bringing about the major benefits described above, will contribute to the improvement in life of a large number of people and is judged appropriate to be implemented under the scheme of Japan's grant aid. The Government of the Philippines has secured the personnel required, mainly in the Maintenance Division of the NCR, and has affirmed that it will be possible to allocate a budget of 30 million pesos every year (the sum corresponding to the budget required annually for implementation of the project) under the Annual Infrastructure Program, meaning that there are no problems in this regard.

For the improvement work implemented on the existing drainage systems under the project to be even more effective, however, appropriate measures (e.g., education of local residents concerning cleaning of the drains, establishment of improved systems for waste disposal) will need to be taken by the Government of the Philippines against illegal dumping of waste into the drains. For this purpose, the National Capital Region of the Department of Public Works and Highways, the agency responsible for implementation of the project, will have to plan and implement strict measures upon thorough consultations and

investigations with other relevant agencies (Metropolitan Manila Commission, city council, etc.). Implementation of long-term plans will also be required for the procurement and management of dumping sites to prevent adverse effects on their surroundings.

Construction of urban drainage systems is progressing apace with the rapid progress of urbanization not only in the area dealt with under the project but also in other parts of Metro Manila and the regional hub cities. In this connection, the need for improvement works on existing drains, similar to those conducted under the project, is expected to increase in the future. From this point of view, high expectations are placed on the Government of the Philippines to accumulate the technologies appropriate for drainage improvement works through the project and to propagate these technologies throughout the country.

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CHAPTER 1. INTRODUCTION

The plan of flood control and drainage for the Manila Metropolitan Area began with the Basic Plan for Flood Control in Manila instituted in 1952 and various projects have since been implemented for flood control on rivers and drainage of stormwater. Despite such projects, serious flood damage has continued to plague Metro Manila. The flood damage is traced to the inadequate maintenance of existing drains resulting in the loss of water flow capacity.

Under these circumstances, the Government of the Philippines has requested the Government of Japan for a grant aid to procure equipment necessary for the execution of the Project for Retrieval of Flood Prone Areas in Metro Manila in harmony with the master plan on Flood Control and Drainage Project in Metro Manila which was concluded in October 1989 under the technical cooperation program of Japan International Cooperation Agency (JICA). Upon the above request, the Government of Japan has decided to provide the grant aid for the project's execution. The project was completed in February 1991.

Knowing the fact that the above project was successfully carried out and flood damage continues to occur in areas not covered by the project due to the malfunction of existing drainage systems, the Government of the Philippines made a request again to the Government of Japan in October 1991 for a grant aid to improve other flood prone areas as Phase 2 of the project. The proposed area covers about 60 km and is located adjacent to the south of the area previously covered. The request includes equipment procurement and a model implementation with a view to transferring technical knowledge required for the operation and maintenance of the equipment. In response to the request, the Government of Japan has decided to conduct a basic design study and JICA organized a study team to carry out the said study from November 2, 1992 to January 20, 1993.

Based on the impact of the previous project (hereinafter referred to as Phase 1 of the Project) and characteristics of the project site, the study team has discussed and confirmed the most appropriate plan to

be performed under the framework of Japan's grant aid, and determined a basic design through the study, the results of which are compiled in this document.

CHAPTER 2. BACKGROUND OF THE PROJECT

2.1 Background of the Project

2.1.1 Outline of Flood Control Projects in the Philippines

Flood Control Works

Basic flood control measures began to be established at the beginning of the century, but work implementation has been extremely slow because of financial constraints. At first, the aim of flood control works was to protect agricultural lands from floods and up to the present agricultural lands provide the economic base of the country.

The first flood control works were the dikes to protect the major granary of the region on the lower reaches of the Pampanga River. These works were later extended to the Agno River and the flood prevention plans for the Pasig River that flow through the city of Manila was formulated in the 1950's.

Flood control works and plans have since been carried out on major rivers throughout the country, but it was only in the 1960's that the first long-term flood control master plan covering a whole river basin was formulated. These were the flood prevention plans for the Pasig River and the flood control master plan for the Bicol River which were established with external technical assistance.

In the 1970's, the government began to extend the long term flood control master plan to other major river basins, where the stagewise development was made towards the final goals with sufficient funding for each stage. Likewise, restoration works and other disaster prevention measures continued to be implemented.

The main theme of the master plans was to cope with the flood overflows of river channels, while measures for urban stormwater drainage also became a major theme in the flood control plan, especially for Metro Manila.

The rapid expansion and increase in population of Metro Manila have, however, necessitated the revision of the basic plan for flood control. Two major floods occurred one after the other in June 1985 and September 1986 and in response, the study for the basic plan of comprehensive flood control in Metro Manila with the aim of coordinating the flood control measures with the development of urban areas has been launched in January 1988 with technical assistance from JICA. This study was completed in October 1989.

Problems at Present and Objectives of the Project

The Department of Public Works and Highways (DPWH), which is the governmental agency responsible for implementing flood control plans, began to undertake surveys throughout the country to upgrade maintenance of the existing flood control facilities and make them function fully in accordance with the Medium-Term Philippine Development Plan. It has been confirmed through the surveys that a majority of the existing drainage systems, riparian works, dikes and protection works require some form of restoration or improvement works.

According to the estimation of the DPWH and the National Economic Development Administration (NEDA), maintenance cost for the existing flood control facilities amounted to 142 million pesos a year. Most of the budget was, however, directed toward the restoration of existing structures on principal rivers and the financing of stormwater drainage facilities in Metro Manila were put in abeyance.

Damage due to flood in Metro Manila, on the other hand, has become increasingly serious every year and about 50% of the damage can be attributed to the inadequacy of stormwater drainage. Furthermore, it has been pointed out in the Study on Flood Control and Drainage in Metro Manila carried out by JICA from January 1988 to October 1989 that the principal cause of malfunctioning of the drains is blockage due to sediment deposits. In view of this situation, the project which aims at the retrieval of the existing drainage system is of considerable significance and it is expected that it will greatly contribute towards the formulation of flood control plans in the future.

2.1.2 Summary of Related Plans

National Development Plan

The following four objectives have been stipulated in the Medium-Term Philippine Development Plan for the period from 1987 to 1992.

- Reduction of poverty
- Creation of productive employment opportunities
- Promotion of social equality and justice
- Achievement of sustained economic growth

An important part of the strategy for achieving these objectives is to enlarge the role of the provinces (there are 13 administrative regions) and local communities in the national development plan. Each administrative region has been given its own development program to reduce the regional inequalities in income resulting from the uneven distribution of development works. The basic policy of the development programs is to aim at activating the national agricultural economy by increasing production and improving living standards.

The government has established development strategies and targets for each of the administrative regions and has directed each region to make full use of their natural human resources. The population, employment rate and gross product for each region are shown in Table 2-1 in accordance with the goals set for 1992.

For the purpose of achieving the regional development targets above, the government obliges the Regional Development Council and the National Economic Development Board to carry out close consultation with the local governmental agencies and to establish investment programs for regional development. The basic policy for infrastructures in the Medium-Term Development Plan is to make full use of the existing facilities by retrieving and maintaining them and thus reduce the need

of investment for new facilities. Together with the promotion of drainage works in Manila, the promotion of improvement works on regional rivers for the protection of agricultural lands from floods and securing high levels of productivity is emphasized in the plans for the establishment of flood control facilities as a part of social infrastructures.

Table 2-1. Targets of Regional Medium-Term Development Plan

Administrative Region	Regional Gross Product* (million Pesos)	Population (million)	Employment Rate (%)
The Whole Country	135,331	64.26	95.1
Metro Manila	37,607	8.38	85.1
I	6,099	4.45	95.9
II	3,916	2.98	96.0
III	12,152	6.42	94.7
IV	19,662	8.52	96.4
V	4,753	4.58	97.7
VI	10,923	5.91	96.2
VII	9,452	4.79	97.8
VIII	3,511	3.48	97.9
IX	5,024	3.33	96.9
X	7,109	3.80	97.2
XI	9,452	4.54	97.1
XII	5,671	3.09	96.9

* 1972 price level

Regional Development Plan

The Metropolitan Manila Authority (MMA, formerly Metropolitan Manila Commission or MMC) had established a Regional Development Framework Plan for the period from 1983 to 1992 for the whole of Metro Manila including the Phase II project area (Pasay City, Makati and a part of Parañaque). This development plan is based on the national development plan described above and aims at the achievement of the following three objectives in order to deal with the rapid growth of population and expansion of the urban area.

(1) Reduction of Poverty

The following items are planned for implementation with the aim of improving the living standard of the low-income population.

- Low interest loans
- Distribution of basic foodstuff at below market prices
- Provision of infrastructure (housing, sanitation facilities, schools, etc.) for low-income population.

(2) Creation of Productive Employment Opportunities

The aim is to increase employment by vitalizing medium and small firms through the liberalization of restrictions on government loans to these firms and the introduction of special loans systems, as well as the establishment of a training program for engineers and technicians. Efforts are also being made to increase employment opportunities abroad.

(3) Creation of Desirable Urban Environment

The main aim is to remove the slum areas by establishing permanent housing for illegal residents and develop the necessary infrastructures such as water supply, electricity, stormwater and sewage drains, roads and communal facilities (hospitals, schools, etc.). In the flood control plan which is a part of the social infrastructure development plan, the immediate and effective reduction of flood damage is emphasized by retrieving the existing drainage facilities in the city of Manila and its vicinity so as to create a desirable urban environment.

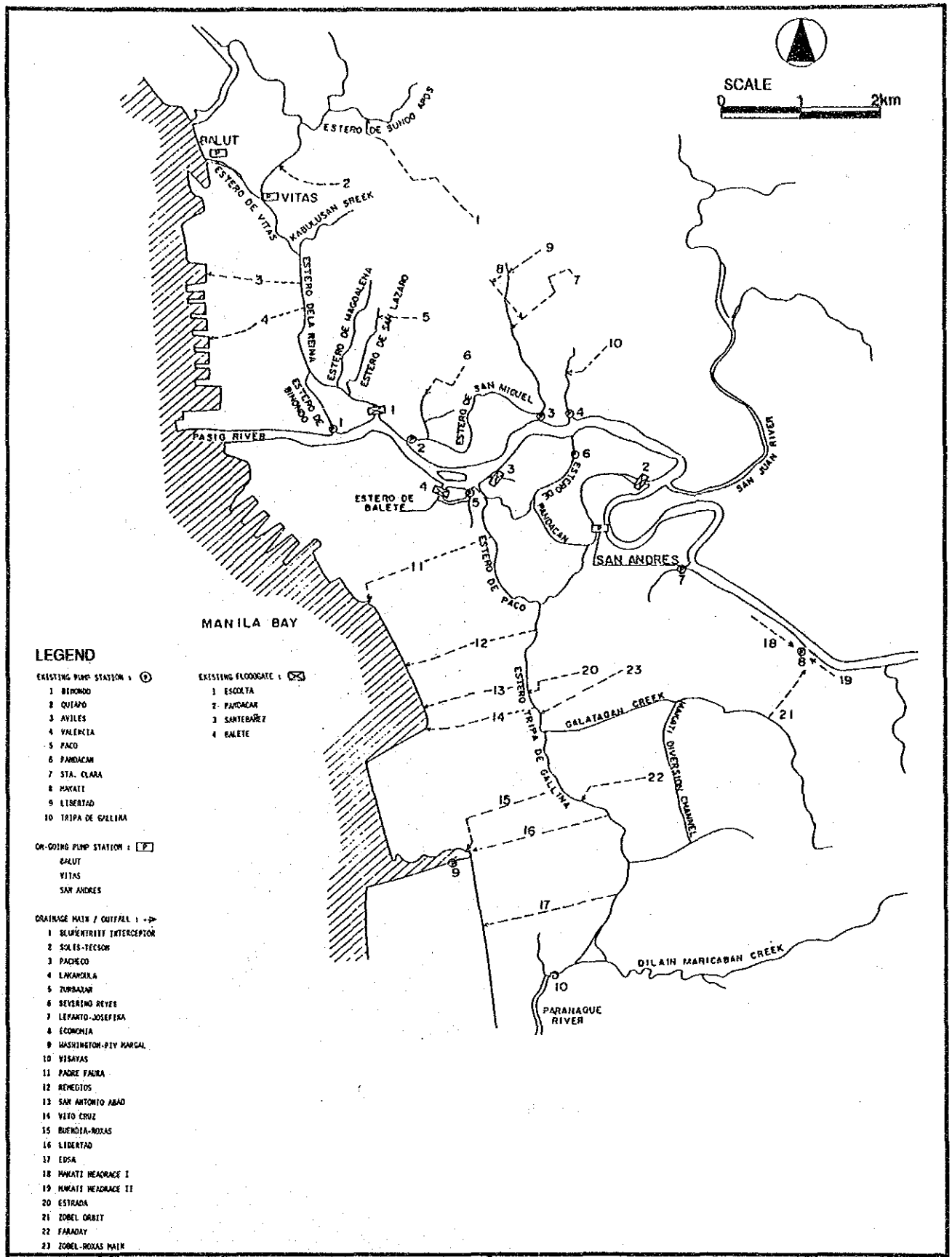
Aside from the city of Manila and its vicinity, the whole of Metro Manila is now rapidly enlarging the urban storm drainage network which will require adequate maintenance in the future. In this connection, the Project for the Retrieval of Existing Drainage System in Metro Manila is regarded as a sort of pilot project and the Government of the Philippines expects to develop the appropriate methodology to be widely implemented throughout the country.

Flood Control Development Plan

The present urban stormwater drainage works in Metro Manila are based on the Drainage Plan for Manila and Suburbs prepared by the Bureau of Public Works (now the Department of Public Works and Highways) in 1952. The works executed so far under this plan are the construction of ten (10) drainage pumping stations, the primary drains with a total length of 121.1 km, and the secondary drains with a total length of 193.8 km (refer to Fig. 2-1). In addition to these, the construction of three (3) pumping stations and improvement of related drains are in progress with financing from the Overseas Economic Cooperation Fund (OECF) of Japan.

Simultaneous with these urban drainage works, works for flood control measures have been carried out on the Pasig-Marikina River that flows through Metro Manila. These works were based on the Marikina River Multipurpose Development Works adopted in 1954, and the construction of the Mangahan Floodway and riparian improvements for the Pasig River have been carried out (refer to Fig. 2-2).

To meet the rapid urbanization and increase in population of Metro Manila, the flood control plan formulated in the 1950's has been deemed to be obsolete under the present conditions. Thus, the Study on Flood Control and Drainage Project in Metro Manila commenced with technical assistance from JICA in January 1988 to update the integrated plan of flood control and drainage system in the region. The Study, which was completed in October 1989, pointed out the need for immediate retrieval of the existing drainage channels and drains, and the basic design study for the project begun against this background.



THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA (PHASE 2)

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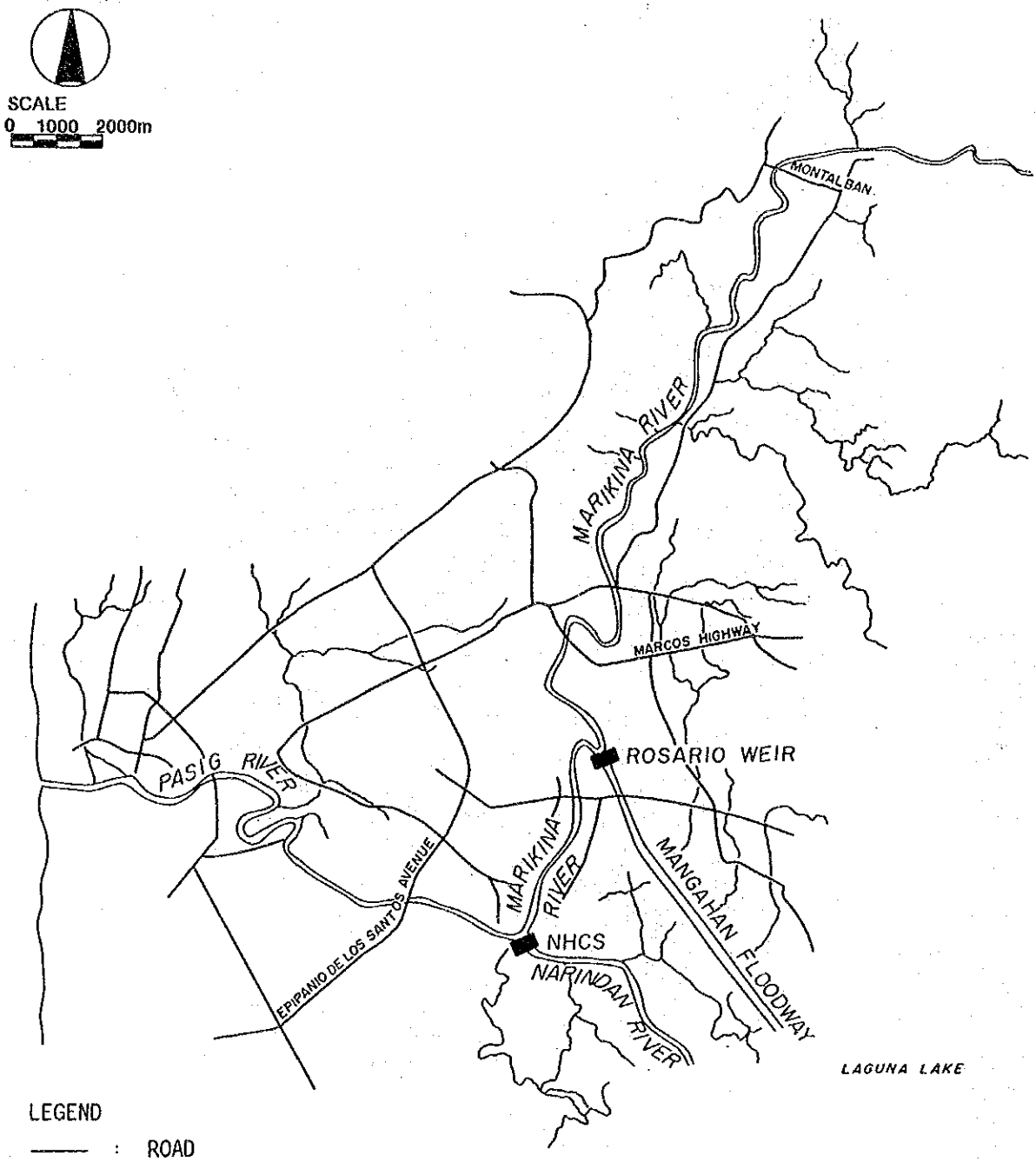
Fig. 2-1 DRAINAGE SYSTEM IN METRO MANILA



THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA (PHASE 2)	Fig. 2-2 PASIG-MARIKINA RIVER AND MANGAHAN FLOODWAY
JAPAN INTERNATIONAL COOPERATION AGENCY	

2.2 Outline of the Request

The first plan for flood control works in Metro Manila including the project area was the Basic Plan for Flood Control in Manila adopted in 1952, and various works for flood control measures and stormwater drainage have since been implemented. Flood control works implemented so far include improvements on the Pasig River which flows through Manila City and the construction of the Mangahan Floodway with financial assistance from the OECF. Ten (10) pumping stations were also constructed in Metro Manila with financial assistance from OECF and the Export-Import Bank of Japan and four (4) of these stations are located within the Phase II project area. A drainage network consisting of esteros (river channels for storm drainage), drainage mains/outfalls (the primary drains) and laterals (the secondary drains) were installed at the same time in association with the pumping stations.

Despite the drainage works mentioned above, flood damage has continued to occur in the city of Manila and its vicinity, and it becomes more serious year by year as urban population grows. The floods have caused extensive damage to houses and public facilities and the disruption of communication and transportation networks, all of which largely affect economic activities and sanitary conditions in Metro Manila.

The main cause of these floods is the inadequate maintenance of the existing drainage channels and drains resulting in their being unable to fulfill their functions. Many of the drainage channels and drains are blocked with sediment deposits and garbage, and they have lost their original flow capacities.

In view of this situation, the Government of the Philippines plans to improve the conditions of the existing drains in Metro Manila within the framework of the Medium-Term Philippine Development Plan (1987-1992), aiming at reducing flood damage to the minimum possible and creating favorable urban environment as well as living conditions.

The Department of Public Works and Highways, the implementing agency of the Government of the Philippines, commenced the retrieval

work for existing drainage systems in the city of Manila in 1990 as the Project for Retrieval of Flood Prone Areas in Metro Manila. This project was undertaken under the grant aid program of the Japanese Government and it includes the procurement of equipment necessary for the retrieval and transfer of technology required for the operation and maintenance of the equipment through the execution of actual retrieval work in a model area. The project area accounts for about 10% of the whole area of Metro Manila and the results show that flood damage has been remarkably alleviated. The Government of the Philippines desires to continue the retrieval work in Pasay City and Makati including a part of Parañaque as Phase 2 of the project, taking into account the result successfully achieved in Manila City, and has made a request for grant aid from the Government of Japan.

The main equipment being requested by the Government of the Philippines is tabulated in Table 2-2.

Table 2-2. Main Equipment Requested

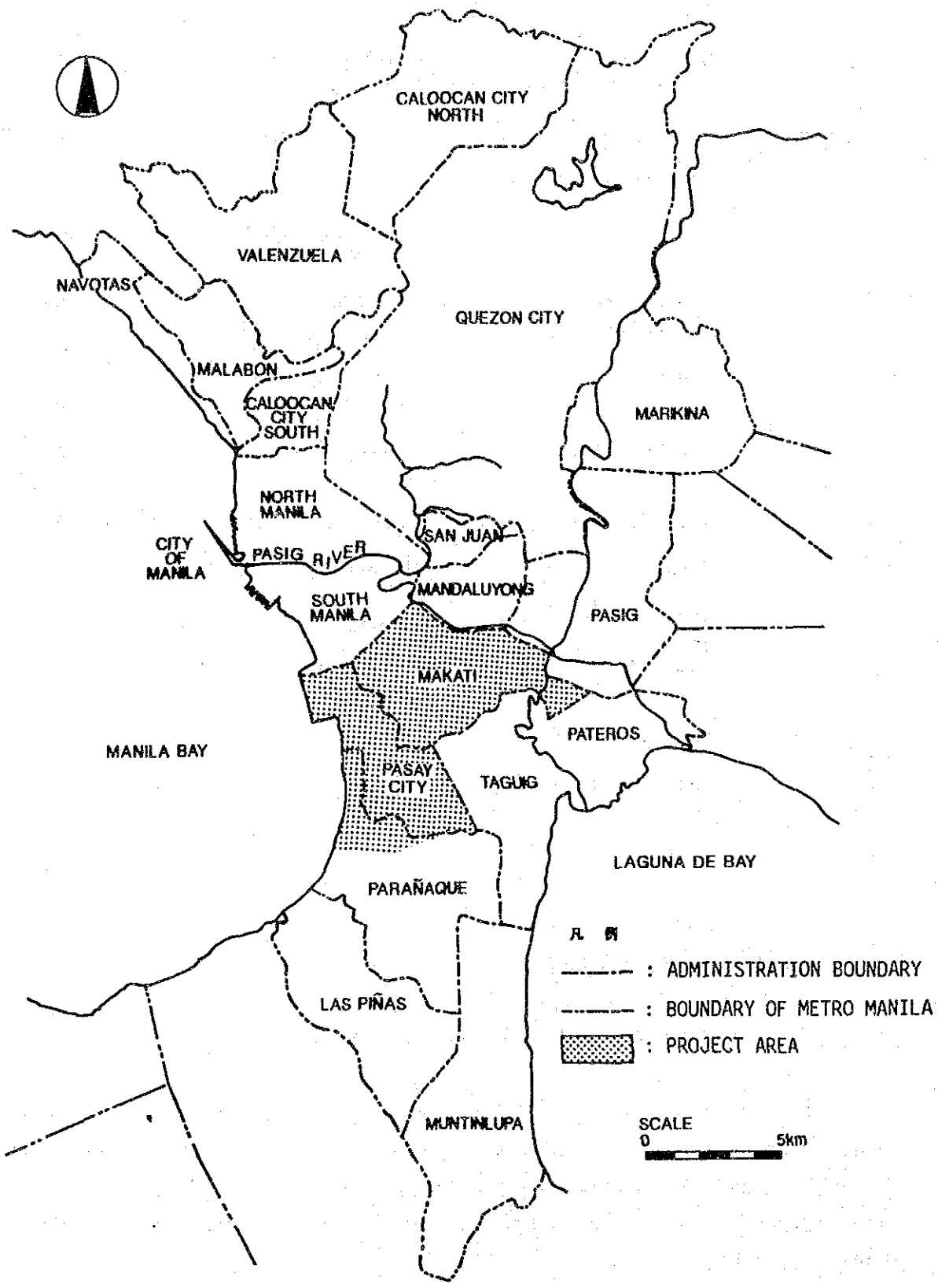
Work Item	Type of Equipment	Specifications	No. of Units
Large Open Channel	Crawler Crane with Clamshell	Bucket: 0.6 m^3	1
	Hydraulic Truck Crane	Loading capacity: 25 tons	1
	Pontoon Barge	20 m x 9 m	1
	Scow	24 m^3, 15 m x 6 m	2
	Tugboat	60 ps, 9 m x 3 m	1
	Dump Truck	Loading capacity: 11 tons	3
Small Open Channel	Hydraulic Excavator with Clamshell	Bucket: 0.2 m^3	3
	Hydraulic Wheel Crane	Loading capacity: 20 tons	3
	Pontoon Barge, Easy Setup Type	12 m x 5 m	3

	Scow, Easy Setup Type	4-6 m^3	6
	Dump Truck	Loading capacity: 4 tons	9
Drainage Main/Outfall	Wheel Crane with Dragline and Clamshell	Bucket: 0.6 m^3	5
	Dump Truck	Loading capacity: 4 tons	10
	Diesel Engine Generator	20 KVA	5
	Blower	Ø300 mm, 0.3 - 0.6 KW	5
	Gas Detector	Oxygen, Methane, etc.	5
Laterals	Waterjet Cleaner	200 - 250 bar	5
	Vacumm Cleaner	Capacity: 1.5 m^3	5
	Water Tanker	Capacity: 3.5 m^3	5
	Dump Truck	Loading capacity: 4 tons	10
Supporting Equipment	Survey Equipment		L.S.
	Walkie-Talkie		30

2.3 Outline of the Project Area

2.3.1 Location and General Conditions of the Area

The project area is located more or less at the center of Metro Manila and, in terms of administrative districts, contains the whole of Pasay City and Makati and a part of Parañaque (see Fig. 2-3). It has an area of 60 km^2 making up approximately 9% of the total area of Metro Manila (636 km^2).



THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA (PHASE 2)

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 2-3 PROJECT AREA AND ADMINISTRATIVE BOUNDARY

The population of the project area, according to information from the National Statistics Commission, is 1.19 million, accounting for approximately 14% of the total population of Metro Manila. The population density of the project area, approximately 198/ha, is far in excess of the average of 130/ha for the whole of Metro Manila and housing in the area tends to be crowded.

The project area, located in the new urban area of Metro Manila, has become noted as a business center. With regard to the gross regional domestic product (GRDP), which provides an indication of the level of economic activities in the area, the figures for the project area are unknown but those for the whole of Metro Manila in 1987 is 28,208 million pesos, accounting for 29% of the total GRDP of the country. The gross domestic product (GDP) per capita of the Philippines in 1989 is 16,040 pesos, far below the average of 39,914 pesos in Metro Manila.

2.3.2 Natural Conditions

The project area is located on an alluvial plain that has developed along the Manila Bay on the lower reaches of the Pasig River. Most of the area lies in low-lying areas of less than 2 m above mean sea level (MSL) and the flow conditions of the river and drains in the area are greatly influenced by the tides in the bay.

There are two seasons, rainy and dry seasons, in the project area. The dry season generally lasts from December to May and the rainy season from June to November. According to the rainfall records of Port Area (Manila), annual rainfall is approximately 2,100 mm and 91% of the precipitation occurs in the rainy season. Furthermore, the project area is located on the path of tropical cyclones, especially between August and November.

There is little variation in temperature throughout the year, with the maximum temperatures remaining between 30°C and 34°C and the minimum temperatures between 20°C and 25°C. Relative humidity remains high throughout the year at between 65% and 85%. Average duration of sunshine is just over 6 hours. Northeasterly winds at annual average

velocity of 0.8 m/s prevail during the dry season and southwesterlies at average velocity of 0.5 m/s during the rainy season.

2.3.3 Social Environment

Roads

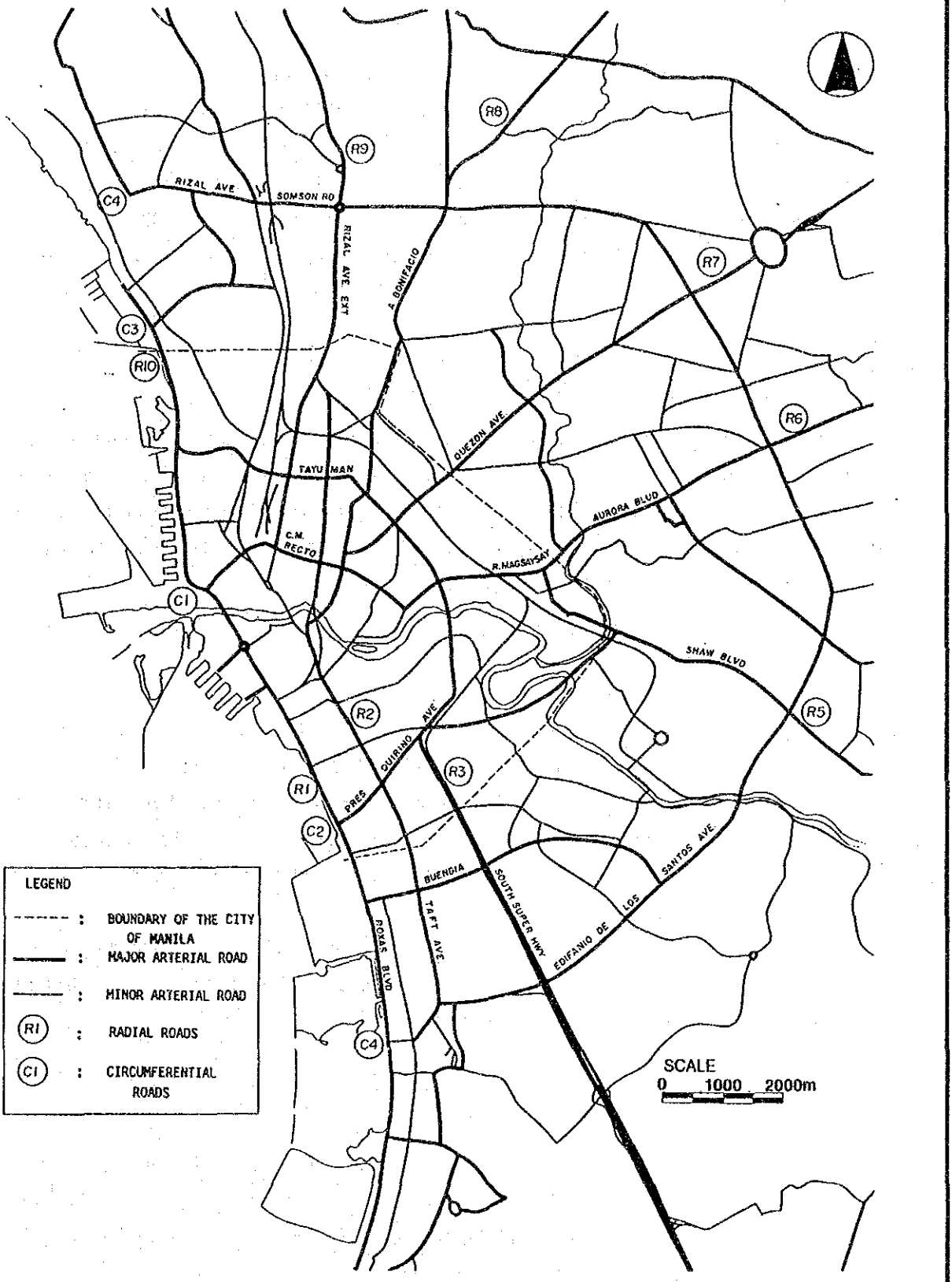
The total length of roads in the city of Manila is 688.9 km, of which 235.1 km are under the jurisdiction of the national government, 46.8 km under the provincial government and 407.0 km under the city government. The road density of 16.4 km/km^2 is the highest in Metro Manila. The road network in Metro Manila is as shown in Fig. 2-4.

Generally, paved roads prevail in the project area. However, those connecting to both major and minor arterial roads are hazardously constructed and their widths were not designed properly to meet the requirement. Heavy traffic jams can be seen in many places in the project area and under such condition time is unexpectedly consumed for people to move by car from one place to another.

Water Supply

Water supply comes under the jurisdiction of the Metropolitan Waterworks and Sewerage System (MWSS). The MWSS completed the second phase of the Manila Water Supply Project in June 1987, allowing the daily water supply of 2,500 million liters. The project was aimed at a high-level use of the existing water source on Angat River and at rehabilitation and expansion of the existing water supply system. Implementation of the project has resulted in 39.1% of the total population of Metro Manila being served by MWSS.

The Manila Water Supply Rehabilitation Project, in progress at present, aims at reducing the loss of water supply in 56 zones (9,541 ha) within the area served by MWSS. Also in progress at present is the Metro Manila Water Distribution Project, which aims at maximizing the use of the water supply capacity enlarged through the Manila Water Supply Project and reap the benefits of the investment as soon as possible.



THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA (PHASE 2)

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Fig. 2-4 MAJOR ROAD IN METRO MANILA

Sewers

There are two sewage networks in Metro Manila. One is the Central Manila Sewage Network covering an area of 1,850 ha in the central part of the city of Manila. The network, completed before 1909 with a capacity for handling sewage produced by a population of 220,000, now has to handle sewage produced by a population of more than 530,000. The other network, handling sewage from the residential and commercial areas of Quezon City and Makati, has a capacity for a total population of 350,000.

The Metro Manila Sewage and Sanitation Project is under way at present and is composed of two parts. The first component entails the rehabilitation and expansion of the existing sewage network in central Manila to cover the service area of MWSS. The other is the sanitation component, aimed at cleaning waterways especially in areas with high concentration of low-income people.

Waste Disposal

The Environment and Sanitation Center of the Metropolitan Manila Authority (MMA) is responsible for the disposal of waste in Metro Manila. The center administers the comprehensive programs for improving the environment through beautification of roads, pedestrian paths and waterways, as well as cleaning of roads and collection of waste.

The daily production of waste in Metro Manila is estimated at 10,000 tons, of which 8,000 tons are collected. The remainder is dumped in nearby waterways, burned or recycled.

2.3.4 Outline of Urban Drainage Facilities

The urban drainage (stormwater drainage) plan for the project area aims at preventing inundation of the area in the occurrence of a 10-year probability rainfall. For this purpose, four (4) drainage pumping stations have been constructed in the area.

The existing drainage channels and drains in the project area can be classified into the following three groups.

Esteros

Esteros are either natural rivers or artificial waterways with widths of 5 to 30 m used as the primary drainage channels. The total length within the project area is approximately 12 km.

Drainage Mains and Outfalls

These are large culverts used as the primary drains. Their sizes vary but, in general, their depths exceed 2 m and their widths 3 m. The outfalls are those connecting the esteros to Manila Bay. The others are simply referred to as "drainage mains." There are 16 mains and outfalls within the project area with a total length of approximately 14 km.

Laterals

These are secondary drains with diameters of 12 to 42 inches running along roads and connected to the drainage mains mentioned above. There are 39 laterals within the project area with a total length of approximately 96 km.

It has been pointed out in the Study on Flood Control and Drainage Project in Metro Manila, begun by JICA in January 1988 and completed in October 1989, that deposits in the drains mentioned above pause a major hindrance to drainage of water in the area. Upon being informed of the results of the study, the Government of the Philippines has taken up the removal of deposits in the existing drains as a major task in the work on urban drainage.

CHAPTER 3. OUTLINE OF THE PROJECT

3.1 Objective

The Manila metropolitan area suffers from flood in every rainy season, which is mainly attributed to the malfunction of the existing drainage system due to inadequate maintenance. Under these circumstances, the Government of the Philippines plans to improve the existing drains in Metro Manila with the following objectives.

(1) Short-Term Objective

Procurement of equipment and establishment of supporting facilities (store yard, work shop and dumping site) will be completed by 1993 for the implementation of Phase 2 of the project. Staff of the National Capital Region (NCR), Department of Public Works and Highways (DPWH) will be engaged in the project to acquire technical knowledge required for the operation and maintenance of the equipment.

(2) Medium and Long-Term Objective

Deposits of about 135,000 m^3 in volume will be removed from the existing drains in the project area covering approximately 60 km^2 for a period of three years from 1994 to 1996, and from 1997 the retrieval work for existing drainage channels and drains is scheduled to be carried out in other areas of Metro Manila.

Since mechanized work is required for the retrieval of the existing drainage system, the availability of proper equipment is indispensable to accomplish the above objectives. In this sense, this project plays an important role as a pilot project providing impact on the whole area of Metro Manila. The project includes the procurement of equipment and transfer of technology required for the operation and maintenance of procured equipment through model implementation. Thus, the function of the existing drainage network in Pasay City and Makati, and a part of Parañaque, can be restored with a view to attain the above objectives.

3.2 Study and Examination of the Request

3.2.1 Pertinence of the Project

Retrieval work on drains has been carried out in Metro Manila by the NCR-DPWH. Work is, however, slow because it depends on manual labor due to lack of proper equipment, and worked distance so far accounts for less than 1% of the total length of the existing drains. In view of these circumstances, the procurement of equipment is judged absolutely necessary to promote improvement of the existing drainage system.

Since various types of equipment are required for the project, and the Government of the Philippines has no sufficient experience in handling them, it is necessary to achieve an actual retrieval work in a model area, as a part of the project, with the aim of transferring technical knowledge for the operation and maintenance of the equipment.

The project area is located in a commercial district covering both Pasay City and Makati, as well as a part of Parañaque. Although a model implementation of the work in a selected area was carried out in Phase 1 of the project, it will be of great significance to achieve a model implementation in Phase 2 also in order that the most appropriate working system can be established to meet local conditions.

The project is expected to reduce flood damage to about 60,000 houses existing in the area which includes neighboring land of the project area. It will also provide social and economic impact to the area by improving the urban environment and alleviating hazardous traffic conditions, which may lead to the realization of economic activities.

NCR has selected a dumping site for dredged or unclogged materials taking into account the natural and social environmental aspects. It is now under the control of NCR for this project.

In view of all aspects mentioned above, the project is judged reasonable to be implemented by the grant aid of the Japanese Government

to benefit Pasay City, Makati and Parañaque where people are actually facing the flood problem.

3.2.2 Implementation and Operation Plan

(1) Organizational Structure

The National Capital Region (NCR), Department of Public Wroks and Highways (DPWH) is the agency responsible for this project. For further details the operational plans are to be prepared by the Flood Control and Water Supply Section under the control of the director of NCR, and the staff of the said Section as well as those of the North and South engineering districts will participate in the field work for the retrieval of existing drains. The Regional Equipment Service is in charge of the maintenance of procured equipment. Personnel of these sections have adequate experience in the retrieval work in Metro Manila and are well reputed for their competence through Phase 1 of the project.

(2) Personnel

The number of personnel to participate in the project is as summarized in Table 3-1. A certain portion of the field works can be entrusted to private firms as the need arises. Judging from the work result through Phase 1 of the project, there seems to be no problem about the capabilities of NCR personnel with regard to the operation and maintenance of the equipment.

Table 3-1. Personnel Required

Particulars	Available Number of Participants in the Project	Required Number of Participants in the Project
Management Staff	17	2
Supervisory Engineers	37	14
Personnel for Field Work	143	70
Personnel for Repair Work	123	30
Total	320	116

The available number of participants are from the Maintenance Division, Regional Equipment Service, and the North and South engineering districts (for details, see Subsection 3.3.1, Executing Agency and Operational Structure). The required number of participants in the project will be recruited from these divisions or offices of NCR.

(3) Financial Plan

Annual budgets allocated to NCR for the last three years are as shown in Table 3-2. Maintenance cost is included in the total annual budget, and it is remarkable that the budget is reduced year by year.

Table 3-2. NCR Annual Budget, 1989-1991
(in million pesos)

Item	1989	1990	1991
Total Budget	130.9	125.7	109.5
Budget for Maintenance Cost	77.0	70.8	55.7

Since the country has fallen into financial distress, there seems to be no possibility to recover the budget for the time being within the same framework. Therefore, the Government of the Philippines plans to finance the project from the budget set aside for the Annual Infrastructure Program. Under this budgetary plan it could be possible to cover all necessary costs for the operation and maintenance of the equipment. According to the Annual infrastructure Program, the budget allocated to the project is as follows:

1994 : 30 million pesos
1995 : 30 million pesos
1996 : 30 million pesos

3.2.3 Related Projects

The following two projects related to the project under discussion are in progress at present.

(1) Metro Manila Flood Control Project

In response to the flood in 1985, the Department of Public Works and Highways (DPWH) executed a feasibility study concerning flood control in Metro Manila and two districts, Vitas and San Andres, were selected as the areas most urgently requiring measures to be taken. On the strength of this study, a plan for the establishment of pumping stations at three locations was adopted as a part of the Financial Assistance Project of the Japanese Government. The project is now underway and is expected to be completed in 1995.

The project sites and items of work are as shown on Fig. 3-1. During the discussions on the loan agreement covering this project, the necessity of retrieval of existing drainage channels to meet the drainage capacity of the three pumping stations was pointed out. It was then agreed that the Government of the Philippines will implement the retrieval of existing drainage channels connecting to the pumping stations solely under financing by local funds. The scope of retrieval work is the dredging of the following four esteros:

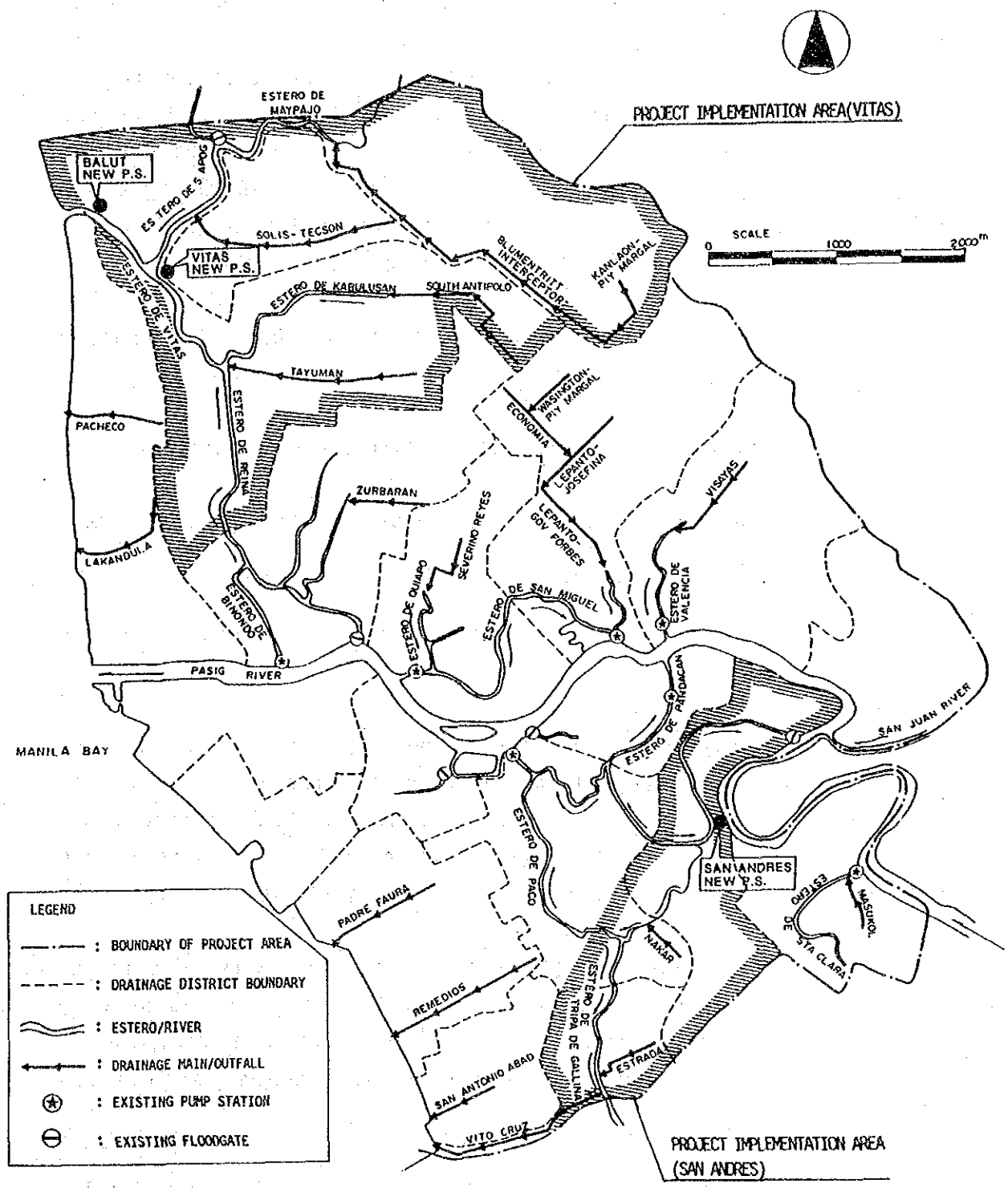
- Two (2) esteros in Vitas District, namely Vitas and Apog.

- Two (2) esteros in San Andres District, namely Pandacan and Tripa de Gallina.

(2) Study on Flood Control and Drainage Project in Metro Manila

The master plan for the Flood Control and Drainage Project in Metro Manila was conducted by JICA on the assumption that the target year is set at 2020. The study was completed in October 1989.

According to the report of the study, many of the existing drainage channels and drains are blocked with sediment deposits and, unless the deposits are remove, newly built drainage facilities will be ineffective. The project under discussion is to respond to this situation by making possible the removal of the deposits through the procurement of necessary equipment.



THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA (PHASE 2)

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Fig. 3-1 IMPLEMENTATION AREA OF METRO MANILA FLOOD CONTROL PROJECT

3.2.4 Equipment Requested

The types of equipment requested are the same as those procured in Phase 1 of the project. They were carefully selected as the most suitable equipment to be employed for the retrieval work in the city of Manila. However, to know the fact that the project area for Phase 2 is different from Phase 1, special attention should be paid in choosing the equipment taking into account the characteristics of the area and working restrictions as well. Technical and economical aspects should also be discussed to determine the basic design of the project.

The equipment requested can be classified into the following three groups:

- Equipment for unclogging laterals (the secondary drains).
- Equipment for unclogging drainage mains/outfalls (the primary drains).
- Equipment for dredging esteros (main water channels for drainage).

Mechanical removal of deposits has been carried out in some part of the esteros and drainage mains/outfalls, but the areas of removal have been limited due to the shortage of equipment. Unclogging work has also been carried out on the laterals by manual labor using simple tools, but the efficiency of this method is extremely low.

In view of the extremely low rate of retrieval work on existing drainage channels and drains, the quantity of deposits has reached 140,000 m^3 in the project area only, so that the mechanical equipment is absolutely necessary for the retrieval work to be carried out efficiently.

In consideration of the water shortage problem in Metro Manila, waterjet cleaners to be employed for unclogging laterals should be new models designed to consume water to the minimum possible by recycle use of water.

The average width of small esteros in the project area is approximately 5.0 m, which is too narrow for a dredger to work in the channel, so that it is more practical to use hydraulic excavators designed to be able to work in muddy water.

The bridge over the Parañaque River, which is classified as a large estero, does not have a sufficient clearance for a dredger to pass through. Therefore, proper measures should be taken in such a way that an easy setup type pontoon barge and scow can be mobilized for the dredging work.

Since traffic is heavy in the project area, the retrieval work on drainage mains/outfalls requires traffic control. All possible efforts should be made to minimize traffic interruption and to provide for safe traffic while at work.

Inasmuch as the equipment and working methods differ from those of Phase 1, it may be necessary to include model implementation in Phase 2 of the project for the purpose of transferring technical knowledge to the staff of NCR regarding the operation and maintenance of the equipment.

3.2.5 Basic Policy in Implementation of the Grant Aid Project

It is judged appropriate to implement the procurement of equipment required for the retrieval of existing drainage channels and drains and to transfer technical knowledge required for the operation and maintenance of the equipment under the grant aid of the Government of Japan. The impact and feasibility of the project and the competence of the executing agency have been confirmed in a positive way through the experience of Phase 1 and further investigations mentioned above. Consequently, the basic design work shall be carried out on the assumption that the project could be implemented by the grant aid of the Government of Japan. The type of equipment requested shall be partly modified in order to be well adapted to the local conditions and restrictions.

3.3 Project Description

3.3.1 Executing Agency and Operational Structure

Maintenance and operation of the drainage channels and drains in Metro Manila come under the jurisdiction of the National Capital Region (NCR), Department of Public Works and Highways (DPWH). Organization charts of the DPWH and the NCR are given in Figs. 3-2 and 3-3, respectively.

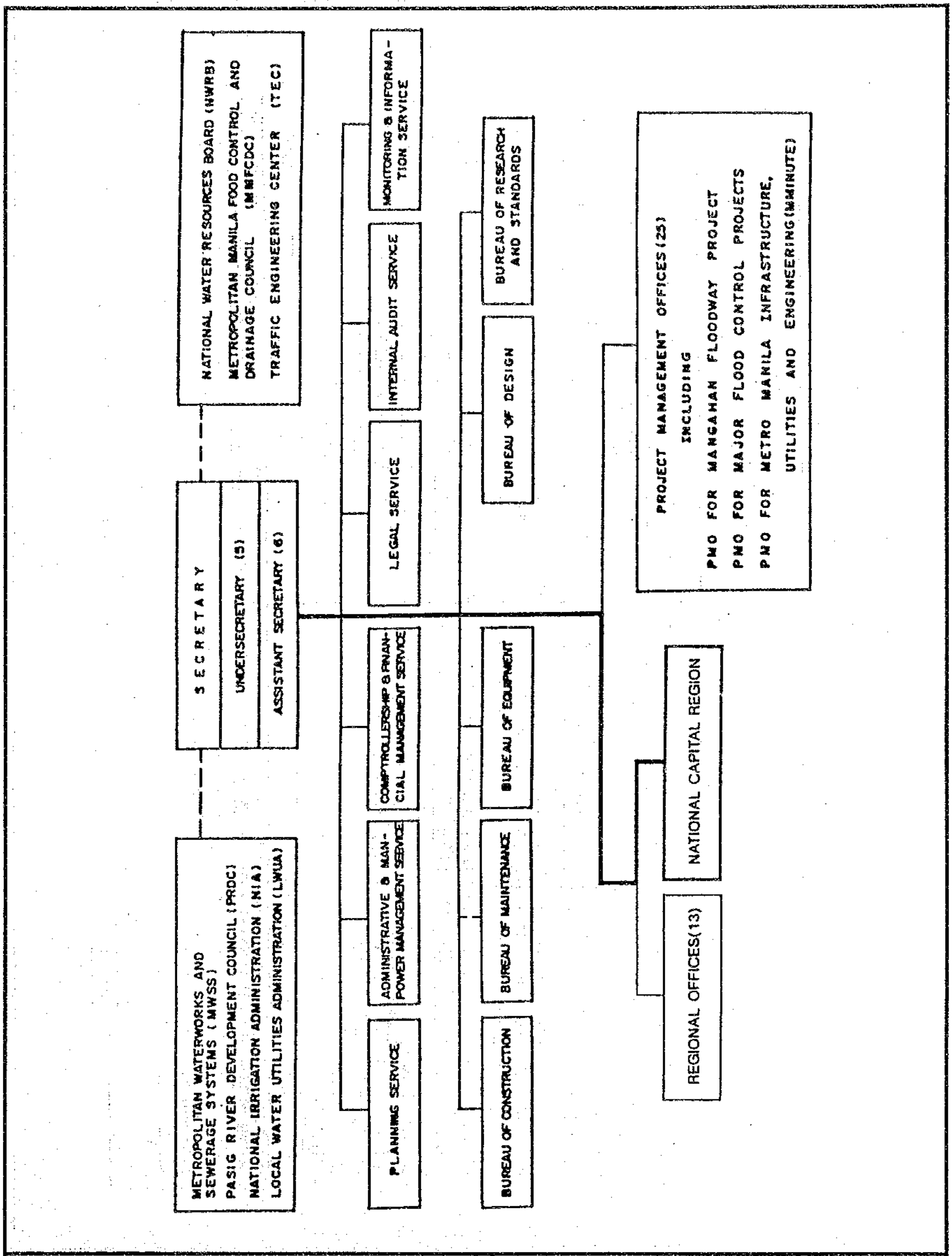
In the organization of NCR, the Maintenance Division, the District Engineering Offices (North Manila and South Manila), and the Regional Equipment Service will be responsible for the operation and maintenance of the equipment procured through the project, and the following staff will be engaged in the implementation under the director of NCR.

NCR Maintenance Division

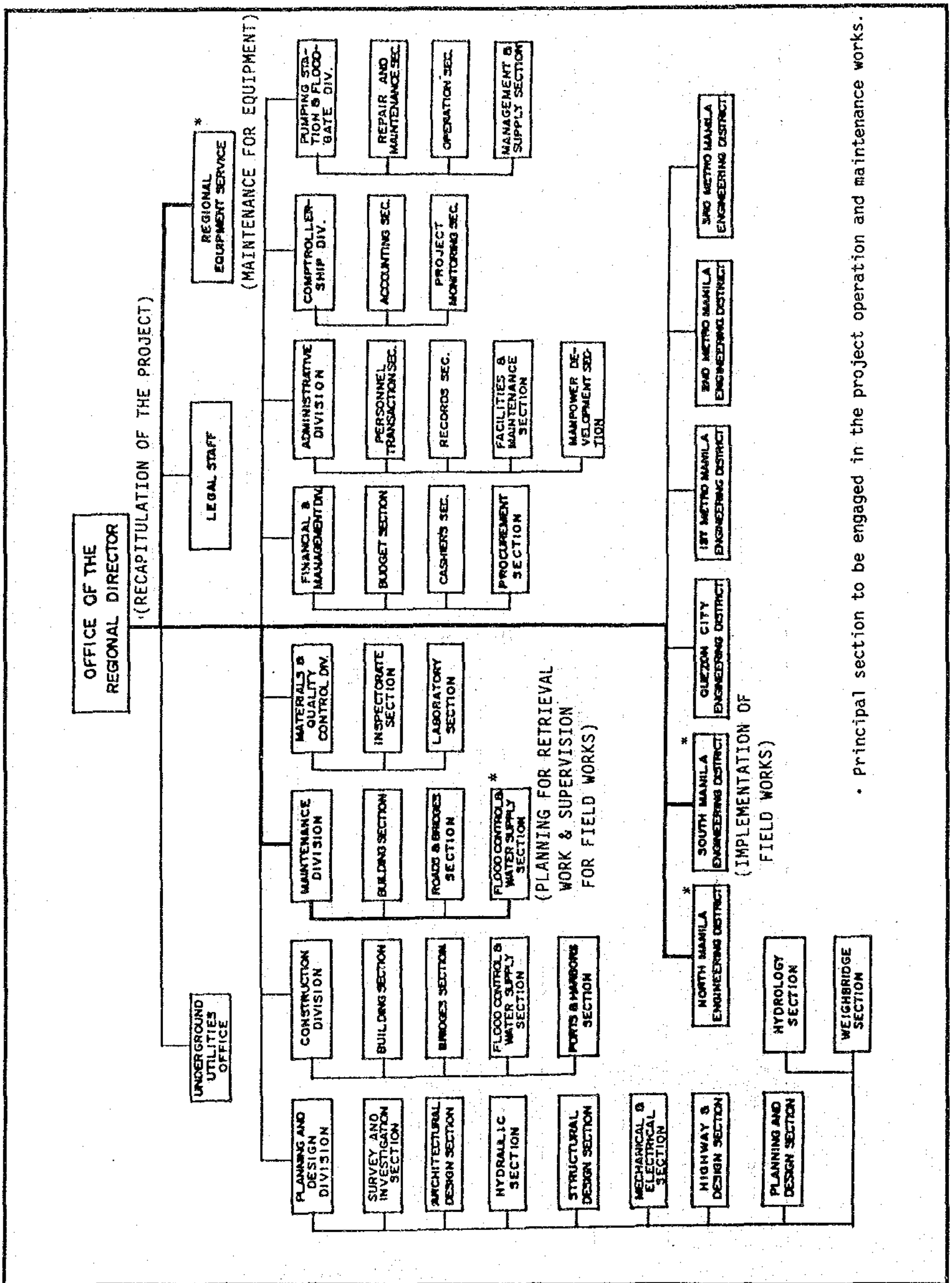
This body is responsible for maintenance and supervision of public facilities in Metro Manila. A total of 145 members of the Flood Control and Water Supply Section will be engaged, according to need, in the operation of the procured equipment. The composition of the staff is as follows:

- Maintenance Engineers	:	4
- Civil Engineers	:	23
- Field Workers	:	100
- Clerical Staff	:	18

Operation of the equipment to be procured through the project will be carried out by the maintenance engineers mentioned above and actual planning and supervision by the 23 civil engineers. Besides the 58 field workers, 42 laborers will be engaged in the field work. Apart from the staff under direct control, there are plans for entrusting parts of the field work to private firms as the need arises.



THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA (PHASE 2)	Fig. 3-2 ORGANIZATION CHART OF THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA (PHASE 2)	Fig. 3-3 ORGANIZATION CHART OF THE NATIONAL CAPITAL REGION, DPWH
JAPAN INTERNATIONAL COOPERATION AGENCY	

NCR District Engineering Offices

There are six (6) engineering district offices under the NCR. Of these, those of North Manila and South Manila will participate in the operation of the equipment to be procured through the project under the guidance of the NCR Maintenance Division. The number of staff participating from the district engineering offices are as follows:

(1) North Manila Engineering District Office

- Management Staff	:	5
- Civil Engineers	:	7
- Field Workers	:	12
Total	:	24

(2) South Manila Engineering District Office

- Management Staff	:	6
- Civil Engineers	:	7
- Field Workers	:	31
Total	:	44

NCR Regional Equipment Service

This department, consisting of the following staff, will be responsible for the repair and maintenance of the equipment.

- Supervisors	:	2
- Marine Equipment Repair Engineers	:	53
- Land Equipment Repair Engineers	:	70
- Clerical Staff	:	26
Total	:	151

3.3.2 Plan of Operation

The drainage channels and drains can be classified into four (4) categories, namely large estero, small estero, drainage main/outfall and

lateral. The length of retrieval drains and volume of deposits to be removed are given in Table 3-3.

Table 3-3. Retrieval Drains and Deposits

Category	Number	Total Length (km)	Work Volume (m^2)
Large Estero (more than 20 m in width)	1	1.79	35,800
Small Estero (less than 20 m in width)	5	10.42	42,300
Drainage Main/Outfall	16	13.51	38,055
Lateral	39	96.14	18,933
Total	61	121.86	135,088

(1) Dredging of Esteros

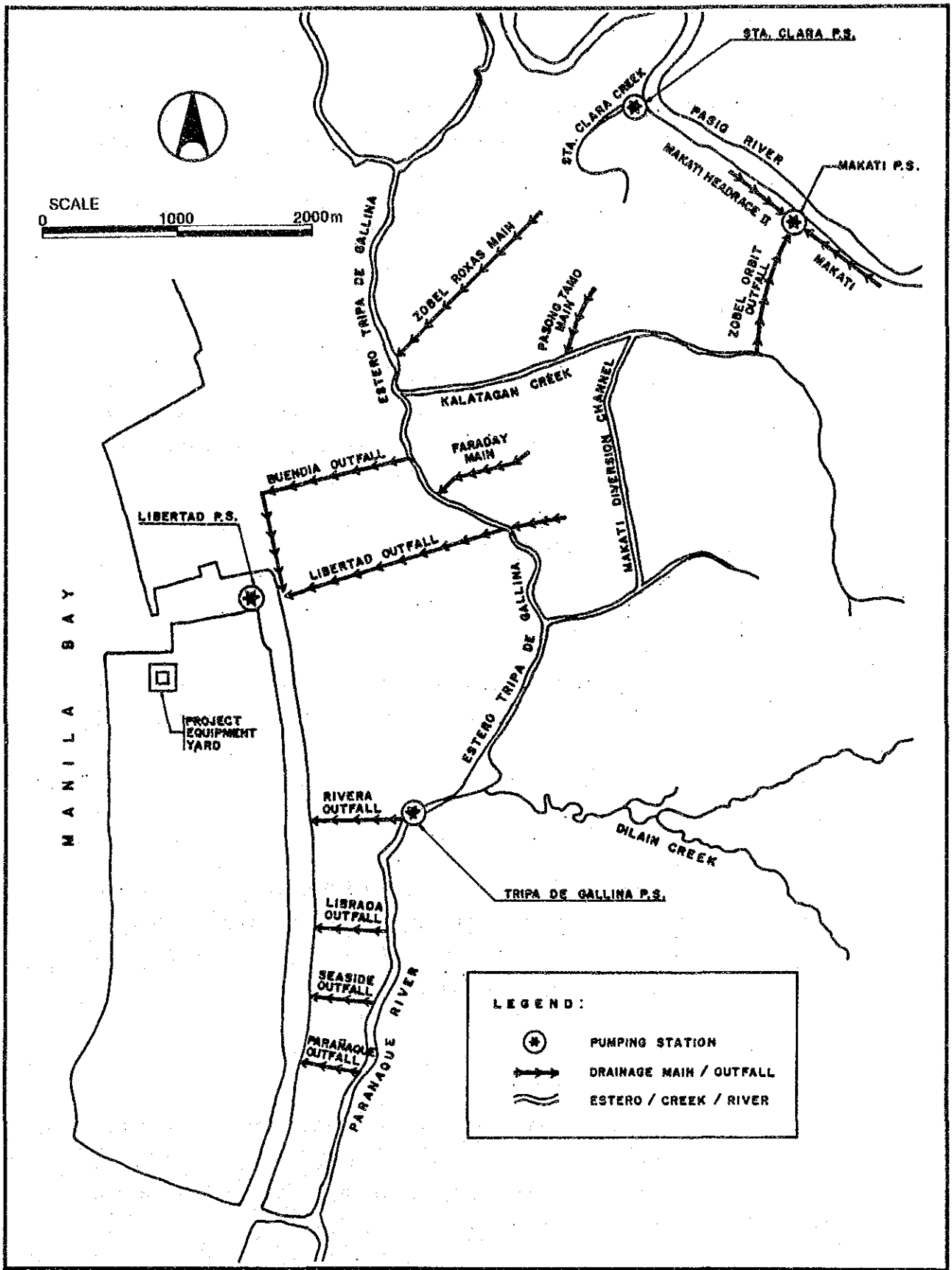
There exist six (6) esteros in the project area of which total length as well as volume to be dredged are shown below. Details and location of each estero are given in Table 3-4 and in Fig. 3-4, respectively.

Total Length : 12,210 m
Work Volume : 78,100 m^3

(2) Removal of Deposits from Drainage Main/Outfall

A total of 16 drainage mains and outfalls are located within the project area. The length, dimension and volume of deposits of each are given in Table 3-5, and Fig. 3-4 shows the location of drainage mains and outfalls. The total length and volume for retrieval work under the project are as follows:

Total Length : 13,512 m
Work Volume : 38,055 m^3



THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA (PHASE 2)

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Fig. 3-4 MAJOR DRAINAGE AREAS IN THE PROJECT AREA

(3) Removal of Deposits from Lateral

All the laterals in the project area are subject to serious blockage due to siltation. The laterials to be cleared under the project (see Table 3-6) consist of culverts with diameters ranging from 12 to 42 inches. The total length and total quantity of deposits to be removed are as follows:

Total Length	:	96,144 m
Work Volume	:	18,933 m^3

Judging from the daily mechanical work efficiency and estimated volume of deposits, the project is supposed to be completed within 2.5 years as proposed by the Government of the Philippines.

3.3.3 Location and Condition of Project Site

Project Area

The project area covers about 60 km^2 accounting for 9% of the whole area of Metro Manila, and it consists of the following five (5) drainage areas.

(1) Makati Drainage Area

The major drains are Zobel Orbit Outfall and Makati Headrace I and Headrace II, all of which are capable of handling stormwater of up to a 10-year return period. The extreme end of this drainage area is designed to discharge water into the Pasig River.

(2) Santa Clara Drainage Area

Estero Santa Clara is the only major channel existing in the area. The drain capacity is said to be not more than that of the pump installed in the pumping station (5.3 m^3/s), which is designed to drain stormwater of less than 5-year return period.

(3) Libertad Drainage Area

The major drainage system consists of Estero Tripa de Gallina, Kalatagan Creek, and three drainage mains and two outfalls. The drained water through outfalls is designed to be discharged into the Manila Bay by pumps. The pump capacity is designed to cope with the stormwater of more than 5-year but less than 10-year return period.

(4) Parañaque and Las Piñas Drainage Area

The area is located at the lower part of Manila Bay. There exist two main channels, Parañaque River running along the Bay and San Dionisio River. The drained water from Tripa de Gallina Pumping Station is once poured into the Parañaque River, then distributed to three outfalls (Rivera, Librada and Seaside) to be discharged into the Bay.

(5) Tripa de Gallina Drainage Area

Estero Tripa de Gallina and Dilain Creek are considered as main channels in this area. Estero de Gallina meets the requirements to drain the stormwater of 10-year return period. However, this is limited to the stretch only between EDSA Outfall and Dilain Creek, and for the rest, less than 5-year return period. The pump capacity is designed to cope with the stormwater of not more than 10-year return period.

Dumping Site

The reclamation area of BASECO has been selected as a dumping site which is located at about 5.0 km north of the Buendia Outfall (see Fig. 3-5). The dumping site is now under the control of DPWH. Although it is a little way off the project area, and work efficiency is supposed to be not as high as expected due to the traffic congestion, there will be no worry about sanitary environmental problems.

Store Yard

The following three (3) sites have been selected as storage yards for the equipment. Their locations are as shown on Fig. 3-5.

- Libertad : The reclaimed land of about 6,000 m^2 adjacent to the Libertad Pumping Station is available to be used for the store yard of equipment.

- Napindan : The existing 2.1 ha of store yard (administered by DPWH) adjacent to Napindan Hydraulic Control Structure at the confluence of the Pasig and Napindan rivers will be used for the storage site of equipment.

- Bicutan : The 0.5 ha site in the compound of the repair shop administered by the DPWH will be used for the storage yard of equipment.

Of the sites mentioned above, Libertad, located closest to the proposed site of retrieval work, is considered to be the main storage yard. At Napindan site there are moorings for dredgers, and repair works can be carried out for pontoon barges and tugboats. Spare parts are kept in a storehouse of 380 m^2 existing in the same yard. Regular disassembly checks and necessary repairs for the equipment are to be carried out in the repair shop at Bicutan.

Table 3-4 Open Channels for Dredging

	Name of Channel	Dredge Length (km)	Average Width (m)	Dredge Volume (m^3)	Outlet Point
1.	Sta. Clara	1.34	6.2	4,000	Pasig River
2.	Tripa de Gallina	3.27	10.3	16,800	Manila Bay
3.	Parañaque	1.79	26.6	35,800	Manila Bay
4.	Makati Diversion Channel	1.41	12.0	8,500	Calatagan Creek
5.	Calatagan Creek	3.00	4.0	6,000	Tripa de Gallina
6.	Dilain Creak	1.40	10.0	7,000	Tripa de Gallina
	Total	12.21		78,000	

Table 3-5 Drainage Mains/Outfalls for Declogging of Sediment Deposits

No.	Name of Drainage Name/Outfall	Length (m)	Size of Culvert/ Pipe Dia.			Sediment Deposits	
			D(m)	W(m)	No.	Blockage for Clear-ance (%)	Deposit Volume (m^3)
1	Zobel Roxas Main	1,016	2.25	4.40	1	41.61	2,616.00
2	Nasukol Main	285	2.00	3.50	1	74.00	1,476.00
3	Buendia Outfall	1,956	3.20	4.60	3	11.10	8,061.00
4	Libertad Main	941	2.50	2.75	1	16.11	1,042.50
5	Libertad Outfall	836	2.91	4.70	1	15.00	1,362.00
6	Faraday Main	808	1.60	1.40	2	13.44	364.50
7	Dolores Main	391	1.52(dia)		-	15.00	75.00
8	Makati Headrace I	486	2.00	2.60	2	1.50	76.50
9	Makati Headrace II	625	2.00	5.00	1	26.64	1,503.00
10	Zobel Orbit Outfall	1,170	3.00	5.00	1	15.00	2,632.50
11	Pasong Tamo Main	550	2.00	3.50	1	63.30	2,442.00
12	Masukol Main	180	2.09	3.00	1	73.69	832.00
13	Rivera Outfall	782	3.00	4.00	1	45.00	3,277.50
14	Parañaque Outfall	520	3.00	4.00	1	45.00	2,808.00
15	Librada Outfall	545	3.55	5.40	1	44.09	4,123.50
16	Seaside Outfall	655	4.15	5.40	1	38.76	5,362.50
	Total	13,512					38,054.50

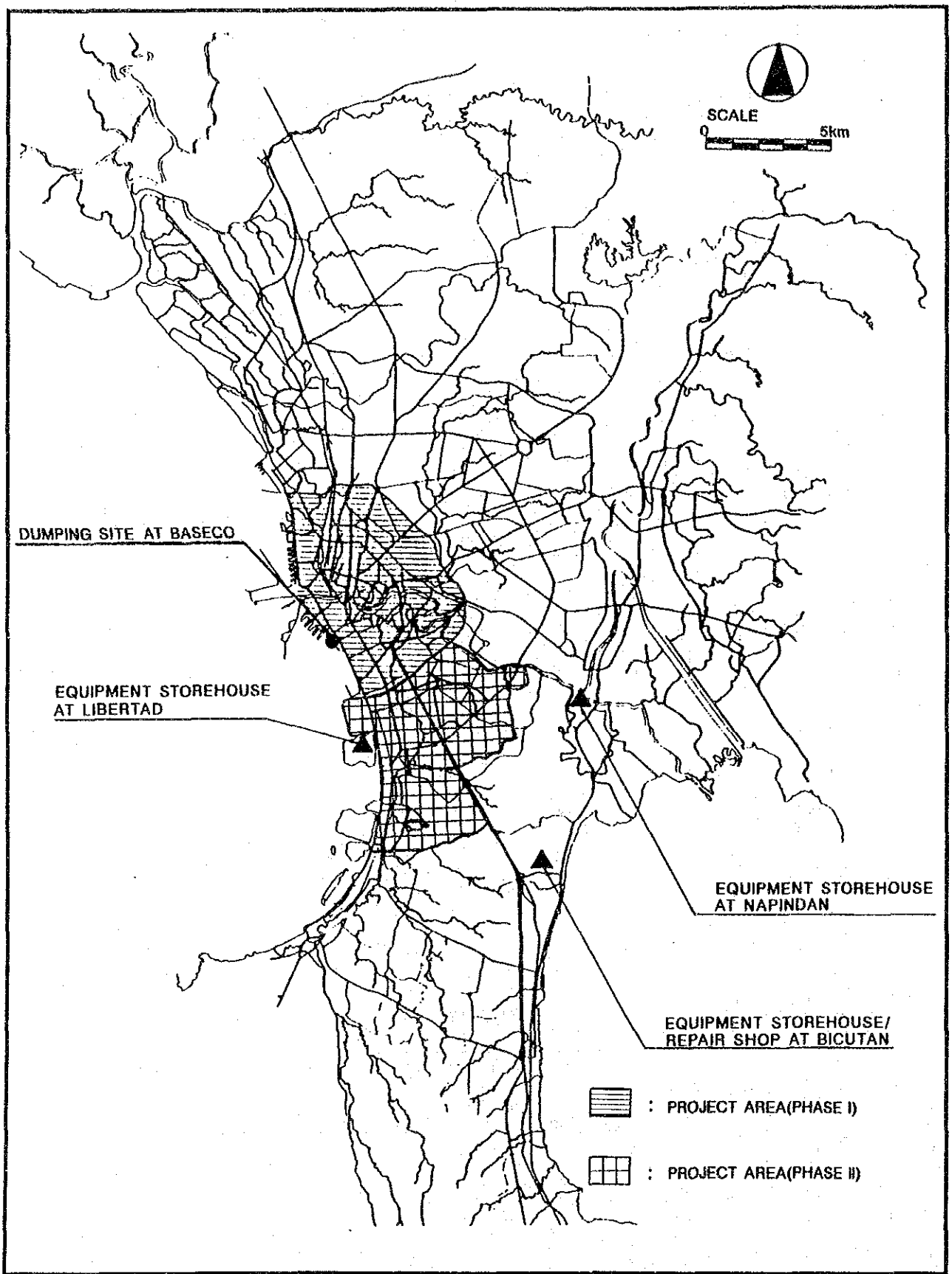
Table 3-6 Laterals for Declogging of Sediment Deposits (1/2)

No.	Name of Street	Length (m) by Diameter (inch)								
		12"	16"	18"	24"	30"	36"	40"	42"	Total
	PASAY									
1	F.B. Harrisson (Vito Cruz-Redemptorist)	31		140			3192			3363
2	Roxas Blvd. (Vito Cruz Seaside Outfall)	425		51	2961					3447
3	Roxas Blvd Service Road (Vito Cruz-T. Alonzo)	248		187	4550					4985
4	PICC Main Road (Roxas Blvd-FAT Access Road)			180			840			1020
5	PICC - Fat Perimeter Road			130			1073			1023
6	PICC - Fat Access Road				244					244
7	PICC - Access Road						280			280
8	Taft Ave. (Vito Cruz-Redemptorist)				3607		4261			7868
11	Tramo Road			2682						2862
14	Pre-Departure Road I Cross Pipes				351					351
15	Nayong Pilipino Access Road				373					373
17	Libertad St. (Roxas Blvd-Tripa de Gallina)				1525					1525
18	Cementina Dolores				658					658
19	MIA Road (from Quirino Ave.-MIA Oval)			311	579		495			1385
20	MIA Oval Road I (Left & Right Side)				620					620
21	MIA Oval Road I (L&R Side)				624					624
22	MIA Oval Main Road II (Left & Right Side)				475					475
23	MIA Oval Outer Road I (Left & Right Side)				120					120
24	MIA Oval Inner Road (Left & Right Side)				120					120
25	MIA Oval Outer Road II				274					274

-- Continued

Table 3-6 Laterals for Declogging of Sediment Deposits (2/2)

No.	Name of Street	Length (m) by Diameter (inch)								
		12"	16"	18"	24"	30"	36"	40"	42"	Total
26	Aurora Blvd (EDSA - Andrew Avenue)				2675					2675
27	Spine Road (Roxas Blvd - PICC Access Road)			260			1080		7180	8520
28	Philtrade Road II								580	580
29	Andrew Avenue (Domestic-Villamor Airbase Gate I)				544		666			1210
30	Domestic Road (MIA Road-Andrew Ave.)	207			671	73	209			1159
31	Gil Puyat Ave. (Roxas Blvd-EDSA)				2563	20				2583
	Sub-Total for PASAY	920	0	3941	23533	93	12096	0	7760	48344
	MAKATI									
1	J.P.Rizal (Del Pan-Fort Bonifacio Gate I)				4659					4659
2	South Drive				1490					1490
3	Fort Bonifacio Nichols Field Road				3649					3649
4	Makati Avenue				795					795
5	Pasong Tamo St. (J.P. Rizal-EDSA)	20		2348	1334		28			3730
6	Pasay Road	27		1125	7423	65				8640
7	MSDR - Makati Side	270	225	132	5124	12930	772			19453
8	Gil Puyat Ave. (Buendia) (Makati Bdry - EDSA)	711		2152	2522					5385
	Sub-Total for MAKATI	1028	225	5757	26996	12995	800	0	0	47801
	Total Length (m)	1948	225	9697	50529	13088	12896	0	7760	96144
	Total Dredge Volume (m^3)	71	15	796	7370	2983	4232	0	3466	18933



THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA (PHASE 2) JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. 3-5 PROJECT DUMPING SITE AND EQUIPMENT STOREHOUSE

3.3.4 Outline of Equipment

In consideration of the work volume and conditions of the project site, the major items of equipment to be used for the retrieval work are determined to be as follows (refer to Chapter 4 for details).

(1) Equipment for Retrieval of Laterals

- Water Recycle Type Jet Cleaner (11-ton, Truck-mounted) : 2 units
- Water Tanker (4-ton, Truck-mounted) : 2 units
- Dump Truck (Loading Capacity: 4-ton) : 8 units
- Floodlight (equipped with engine) : 2 units

(2) Equipment for Retrieval of Drainage Main/Outfall

- Hydraulic Wheel Crane : 3 units
- Dragline Equipment : 6 units
- Dump Truck (Loading Capacity: 4-ton) : 9 units
- Truck (6-ton) : 6 units
- Blower : 6 units
- Diesel Engine Generator (20 KVA) : 3 units
- Gas Detector : 3 units
- Floodlight (400W) : 6 units

(3) Equipment for Retrieval of Large Estero

- Clamshell Crawler (Bucket Capacity: 0.6 m^3) : 1 unit
- Pontoon Barge (Easy Setup Type) : 1 unit
- Tugboat : 1 unit
- Scow (Easy Setup Type, Hopper Box 2 m^3 x 12) : 2 units
- Hydraulic Truck Crane : 1 unit
- Dump Truck (Loading Capacity: 11-ton) : 3 units

(4) Equipment for Retrieval of Small Estero

- Amphibious Soft Terrain Excavator (for muddy water, Bucket Capacity: 0.2 m^3) : 2 units
- Amphibious Soft Terrain Carrier : 4 units
- Hydraulic Wheel Crane : 2 units
- Dump Truck (Loading Capacity: 4-ton) : 10 units

(5) Supporting Equipment

- Surveying Equipment : 1 set
- Walkie-Talkie : 1 set

3.3.5 Operation and Maintenance Plan

Maintenance Structure

The director of the National Capital Region (NCR), Department of Public Works and Highways (DPWH), will have the ultimate responsibility for the operations, and the NCR Maintenance Division and NCR Regional Equipment Service will be responsible for the maintenance work involved in the retrieval of the existing drainage channels and drains, including maintenance and repair of the equipment to be procured under the project.

The NCR Maintenance Division is to be directly responsible for operating the equipment to carry out the actual retrieval works. It will also be responsible for the supervision of the work (schedule control and work progress control), safety control as well as labor and cost management. Furthermore, the Division is in charge of managing the supply of fuel and water required for mechanical work.

The NCR Regional Equipment Service will manage the three equipment storehouses designated for the project and will be responsible for the maintenance of the construction machinery used in the retrieval work. Management work related to the machinery includes planning of the procurement of spare parts and their maintenance (including usual on-site maintenance and regular overhauls).

Maintenance Duties

Taking into account operational stoppages due to rainfall and holidays, and the time taken up for repairs and maintenance of the equipment, the number of equipment operation days in a year is estimated to be 230 (see Subsection 4.2.2). During this period, operations using 60 construction machines will be executed simultaneously with each other. The quantity of fuel consumption and number of field workers mobilized per day are estimated as follows:

- Daily Consumption of Fuel (Gas Oil) : 2,900 liters

- Field Workers Mobilized per Day : 268 men

On-Site Supervisors	:	9
Construction Machinery Operators	:	169
General Workers	:	90

The NCR is required to carry out the following works in order to raise work efficiency and to avoid accidents that might occur during the course of work.

(1) Schedule Management

To prepare the annual implementation schedule in order that the work progress can be controlled thereby.

(2) Construction Management

To establish operational plans for the construction machinery and workers to facilitate the management of on-site work.

(3) Cost Management

To establish plans for annual expenditures to be used for project cost management.

(4) Equipment Management

To carry out spare parts control as well as management of services for overhauls and repairs of the equipment.

(5) Safety Management

To take safety measures for the prevention of accidents while at work.

(6) Labor Management

To provide the required number of workers and health care.

Maintenance Cost

The costs for the operation and maintenance of the equipment to be borne by the Government of the Philippines is approximately 29.8 million pesos per year. It should be noted that a period of about 27 months is required after the model implementation up to the completion of the whole retrieval works. Consequently, the total cost to be borne by the Government of the Philippines is estimated to be about 67 million pesos. The details of annual operation and maintenance costs are as follows:

(1) Cost of Fuel (Gas Oil)

2,900 ltr/day x 230 days
x 7 pesos/ltr : 4.7 million pesos

(2) Cost of Overhauls and Repairs of Equipment

5.0% of Equipment Cost : 10.8 million pesos

(3) Labor Cost : 10.7 million pesos

- Foreman

  9 persons x 320 pesos x 230 days : 0.7 million pesos

- Special Machine Operator

  19 persons x 260 pesos x 230 days : 1.1 million pesos

- Regular Machine Operator

  65 persons x 180 pesos x 230 days : 2.7 million pesos

- Assistant Operator

  66 persons x 160 pesos x 230 days : 2.4 million pesos

- Senior Sailor

  2 persons x 330 pesos x 230 days : 0.2 million pesos

- Sailor

  17 persons x 240 pesos x 230 days : 0.9 million pesos

- Laborer

  90 persons x 130 pesos x 230 days : 2.7 million pesos

(4) Cost of Temporary Works : 1.0 million pesos

- Cost of Safety Measures

  9 teams x 37,000 pesos : 0.3 million pesos

- Cost of Survey

  5 km x 100,000 pesos/km : 0.5 million pesos

- Cost of Temporary Facilities,
  Lump Sum : 0.2 million pesos

(5) Administrative Cost,
10% of (1)+(2)+(3) : 2.6 million pesos

Grand Total : 29.8 million pesos

The Government of the Philippines plans to raise 30 million pesos annually from the budget of the Annual Infrastructure Program for the purpose of financing the project. Should the fund be raised, it could be possible to cover the above cost necessary for the operation and maintenance.

CHAPTER 4. BASIC DESIGN

4.1 Design Policy

4.1.1 Equipment Procurement Policy

The basic policy in planning the procurement of equipment is as follows:

(1) Most of the dredging work will be performed in urban districts, therefore, in selecting the equipment and determining its scale, number and specifications, priority is to be given to work efficiency and safety. Furthermore, a work plan is to be established so that a group of selected equipment can facilitate a series of dredging work.

(2) The increase of discharged water in the drainage channels and drains during the rainy season between June and November may cause major obstacles to work on the removal of the deposits therein depending on the class of the equipment to be used, especially as regards work in the drainage mains/outfalls and the laterals. To enable the annual work load target to be reached without unnecessarily increasing the number of equipment, equipment that will, in principle, allow work to continue during the rainy season will be selected.

(3) In the dredging work on the esteros, partial removal of houses along the waterways (inhabited mainly by illegal residents) will facilitate transportation of equipment to the sites. However, upon consultation with the officials of the Government of the Philippines, it has been decided that selection of the dredging equipment and the model implementation will be carried out on the assumption that there will be no removal of houses along the waterways.

(4) Equipment to be selected can minimize environmental and sanitation problems during the removal and transportation of deposits.

(5) The small esteros to be dredged have a width of as little as 5.0 m, making it difficult to dredge with a dredger. Due to this situation, excavation machines that can be used in the waterways will be selected.

(6) Many of the structures crossing the esteros to be dredged such as bridges and water pipes have inadequate clearance for the passage of dredgers. Hence, pontoon barges and scows that can easily be dismantled and reassembled at the points of obstruction will be selected.

(7) Since there is a chronic water shortage in the metropolitan area of the Philippines, a new model of water jet cleaner that allows water to be recycled is to be used for unclogging the laterals.

(8) Consideration will be given so that the spare parts that are difficult to obtain in the Philippines are to be included in the grant aid.

4.1.2 Construction Policy

The construction policy using procured equipment is as follows:

(1) Only small areas of esteros are served by access roads for maintenance, making it difficult to dredge them with equipment stationed on the banks. The waterways of the esteros themselves will need to be used as the main access routes.

(2) The deposits in the drainage mains/outfalls contain a great amount of vinyl and large solid waste. Furthermore, most of the drainage mains/outfalls are made up of large box culverts of more than 2.0 m deep and 3.0 m wide, with the

depth of water reaching 1.0 m even in the dry season. In view of these conditions, the dragline method of deposit removal currently in use in the Philippines seems to be the most appropriate method.

(3) Access into the drainage mains/outfalls is through the maintenance holes located at intervals of about 50 m. These maintenance holes are rectangular with concrete manhole covers (width: 1.5 to 4.4 m). Although they will allow introduction into the box culverts of equipment such as buckets, cranes are required for removing the manhole covers.

(4) Many of the drainage mains/outfalls are located under the middle of existing roads. While this facilitates the introduction of equipment, it also means that mechanical removal of deposits, requiring restrictions on traffic, can normally be carried out at night.

(5) Taking into account of widths of the roads and the volume of traffic, it will be appropriate to use 4-ton dump trucks for transportation of deposits from the removal sites to the dumping sites. Only the traffic conditions around the larger esteros will allow the passage of larger (11-ton) dump trucks.

4.2 Study and Examination on Design Criteria

4.2.1 Conditions for the Project Scale

The scale and specifications of this project are based on the following conditions:

(1) The drains for retrieval include large esteros, small esteros, drainage mains, outfalls and laterals. The work volume is designed to be approximately 135,000 m^3 (see Subsection 3.3.2 for details).

(2) Based on the estimated work volume and experienced work efficiency through Phase 1, the implementation period is to be 2.5 years as scheduled by the Government of the Philippines.

(3) Judging from the estimated work volume and required implementation period, implementation of this project will be carried out by mechanical works with high work efficiency.

(4) Work efficiency and the required number of equipment are calculated according to the following standards:

"Kensetsu-Sho Doboku Koji Sekisan Kijun"
("Cost Estimation Standard for Civil Works")

"Kowan-Kuko Ukeoi Koji Sekisan Kijun"
("Cost Estimation Standard for Construction of Harbors and Airports")

"Gesuido Shisetsu Ijikanri Sekisan Yoryo (An)"
("Cost Estimation Standard for the Maintenance of Sewage Facility (Proposed)")

4.2.2 Duration of Equipment Use

The possible duration of equipment use, which is a basic condition in deciding the required quantities of equipment, is as follows.

(1) Average Daily Working Hours

Judging from the working conditions at the site, it is assumed to be appropriate in this project to use the equipment for one 8-hour work shift as is usual in the Philippines. Within these 8 working hours, 2 hours will be utilized for preparation and clearing away (transportation, adjustment and maintenance of equipment). Therefore,

the duration of actual operation per day will be 6 hours, without allowing for operation stoppage due to weather conditions such as rain.

(2) Working Days Per Year

Since the equipment is to be used on esteros and stormwater drains (drainage mains/outfalls and laterals), the number of days the equipment can be operated will be affected by the quantity of rainfall. In this connection, the number of hours of interrupted equipment operation due to the quantity of rainfall was standardized as below from the actual experience in Japan.

Interruption of Operation Due to Daily Rainfalls

Daily Rainfall	Interruption Per Day (hours)
Less than 1 mm	0
1 mm to 10 mm	3
10 mm to 12 mm	4
12 mm to 15 mm	5
More than 15 mm	6

Note: Net working hours taken as 8 hours per day.

The frequency of daily rainfalls recorded at Port Area Gauging Station in the Phase 1 project area for the period from 1974 to 1988 is as shown in Table 4-1.

From the standard interruption of equipment operation due to rainfall (refer to the above table) and the records of daily rainfall in the project area (refer to Table 4-1), the monthly interruption days in the project area are estimated at 8.7 days as the average value during the rainy season and 1.4 days during the dry season. In addition to the interruptions due to rainfall, interruptions due to holidays/equipment repair are taken as 5 days per month. Taking these interruptions into account, the number of possible equipment operation days per month is estimated as below (refer to Table 4-2).

Rainy Season (June to November) : 17 days
Dry Season (December to May) : 24 days

Making allowance for the time taken up in preparation work and disassembly/maintenance of equipment, the number of days of equipment operation during the first year is estimated as follows. In this case, allowances are made for an interruption of one month in the rainy season for preparation work/trial operation of equipment.

(24 days x 6 months + 17 days x 5 months) ≒ 230 days approx.

In subsequent years, the number of days of equipment operation is estimated as follows. Allowance is made for an interruption of one month in the rainy season for disassembly/maintenance.

(24 days x 6 months + 17 days x 5 months) ≒ 230 days approx.

4.3 Basic Plan

4.3.1 Determination of Retrieval Method

(1) Retrieval of Laterals

The water jet cleaning method is employed in which sediment in the drains is broken into watery mud by pressurized water and then sucked up by a water recycle vacuum cleaner. The water recycle vacuum cleaner separates the water from the sediment, discharging the water back into the drains.

This method is particularly effective for work in urban districts where a water supply is difficult to obtain, as the minimum of only one water tanker is required. The water jet cleaning method will also minimize the generation of foul odors during the removal and transportation of sediment, since the water recycle vacuum cleaner separates the foul water from the sediment and returns it into the drains without being exposed to the air. Furthermore, multiple works are mechanically performed by a single cleaner, requiring only limited working space.

Table 4-1. Frequency of Daily Rainfalls (1974-1988)

Range of Daily Rainfall	Number of Days (Monthly Average from 1974 to 1988)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Below 1 mm	29.0	27.5	30.4	28.2	24.7	14.8	14.6	10.0	12.4	13.2	20.3	25.3	250.4
1 mm to 10 mm	1.5	0.6	0.6	0.8	3.0	7.4	8.5	8.5	9.6	9.4	6.2	3.7	59.8
10 mm to 12 mm	0.1	0.0	0.0	0.1	0.6	0.9	1.6	0.7	1.9	0.5	0.7	0.2	7.3
12 mm to 15 mm	0.1	0.0	0.0	0.2	0.4	1.1	0.9	1.8	0.7	0.9	0.7	0.6	7.4
Over 15 mm	0.3	0.1	0.0	0.7	2.3	5.8	5.4	10.0	5.4	7.0	2.1	1.2	40.3

Note: Observed at Port Area Gauging Station, City of Manila

Table 4-2(1/2). Monthly Workable Days
(Average: 1974-1988)

Rainy Season (June to November)

Description	Jun	Jul	Aug	Sep	Oct	Nov	Ave
(1) Total Interruption Hours of Operation Due to Rainfall	66.1	68.8	97.3	72.3	76.7	37.5	69.8
(2) Interruption Days of Operation Due to Rainfall	8.3	8.6	12.2	9.0	9.6	4.7	8.7
(3) Interruption Days of Operation Due to Holidays/Equipment Repair	5.0	5.0	5.0	5.0	5.0	5.0	5.0
(4) Total Interruption Days of Operation	13.3	13.6	17.2	14.0	14.6	9.7	13.7
(5) Workable Days During the Rainy Season	16.7	17.4	13.8	16.0	16.4	21.3	16.9

Note: (2) = (1) / (Daily Basic Work Hours: 8 Hours)

Table 4-2(2/2). Monthly Workable Days
(Average: 1974-1988)

Dry Season (December to May)

Description	Dec	Jan	Feb	Mar	Apr	May	Ave
(1) Total Interruption Hours of Operation Due to Rainfall	22.1	7.2	2.4	1.8	8.0	27.2	11.5
(2) Interruption Days of Operation Due to Rainfall	2.8	0.9	0.3	0.2	1.0	3.4	1.4
(3) Interruption Days of Operation Due to Holidays/Equipment Repair	5.0	5.0	5.0	5.0	5.0	5.0	5.0
(4) Total Interruption Days of Operation	7.8	5.9	5.3	5.2	6.0	8.4	6.4
(5) Workable Days During the Dry Season	23.2	25.1	22.9	25.8	25.0	21.6	23.9

Note: (2) = (1) / (Daily Basic Work Hours: 8 Hours)

(2) Retrieval of Drainage Mains and Outfalls

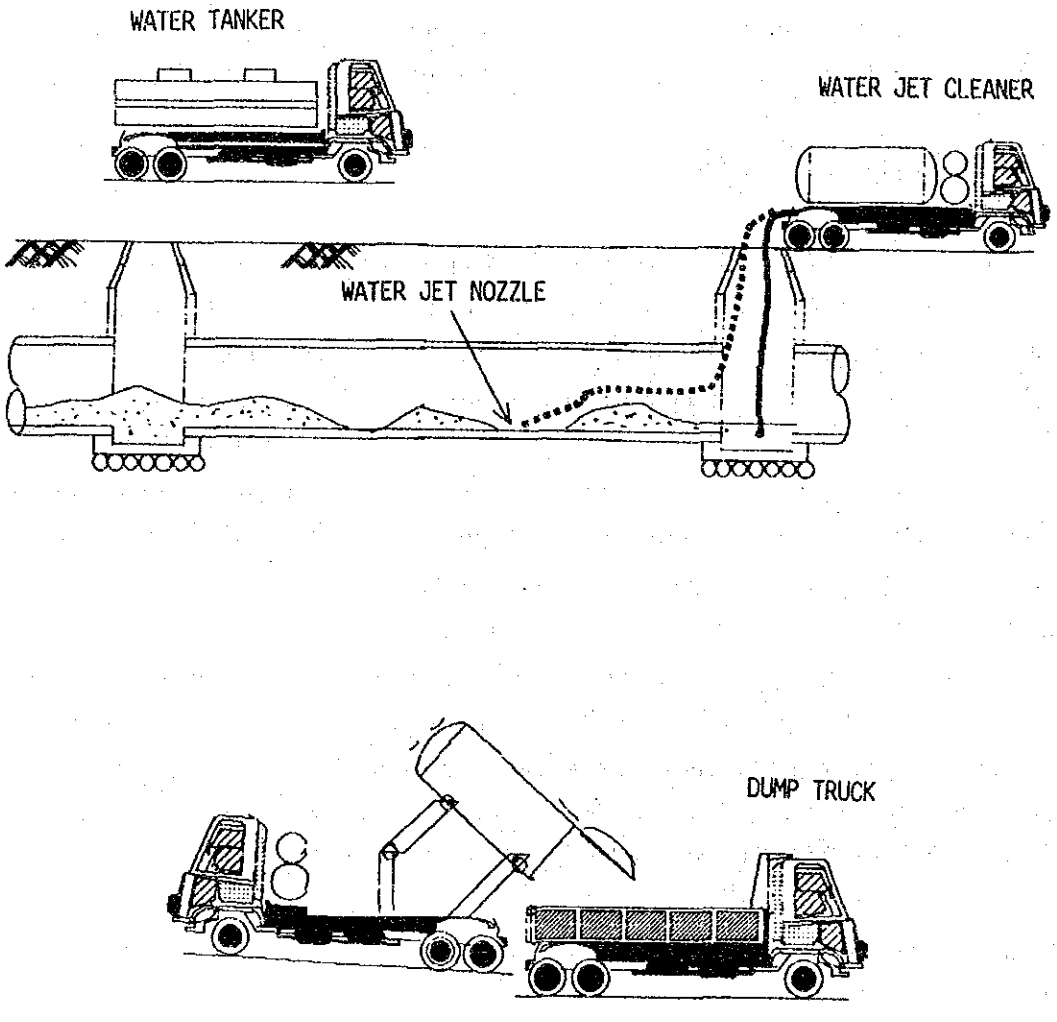
The dragline method is employed to remove sediment from large box culverts. In this method, a crane with attachments collects sediment with a dragline bucket and then removes and dumps the sediment collected around culverts into dump trucks at the site by the use of a clamshell bucket. This method is most safe and effective for this project, since the concrete maintenance hole is large enough to introduce a dragline bucket or a clamshell bucket attached to a wheel crane into the drains.

(3) Retrieval of Large Esteros

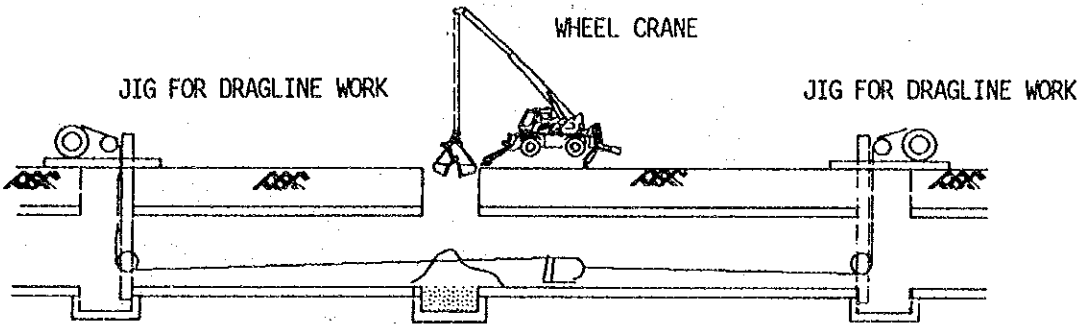
Due to the reasons that the existing esteros contain a great volume of floating garbage and sediment, and that a considerable volume of garbage is contained in such sediment, the glove dredging using a clamshell bucket is considered to be the most appropriate method. Glove dredging is performed by the use of a pontoon barge mounted with a crawler crane equipped with a clamshell bucket. The dredged sediment will be packed in a hopper box and transported to the dumping site by a scow. The objective esteros included in this project belongs to the Parañaque River. The river itself has no problem with the passage of a pontoon barge and a scow in terms of width and depth, however, the width/height of the girder of bridges is not sufficient. Therefore, a pontoon barge and a scow that are easy to dismantle and reassemble will be employed so as to allow dismantlement under the bridge where the passage is difficult and reassembling above the bridge.

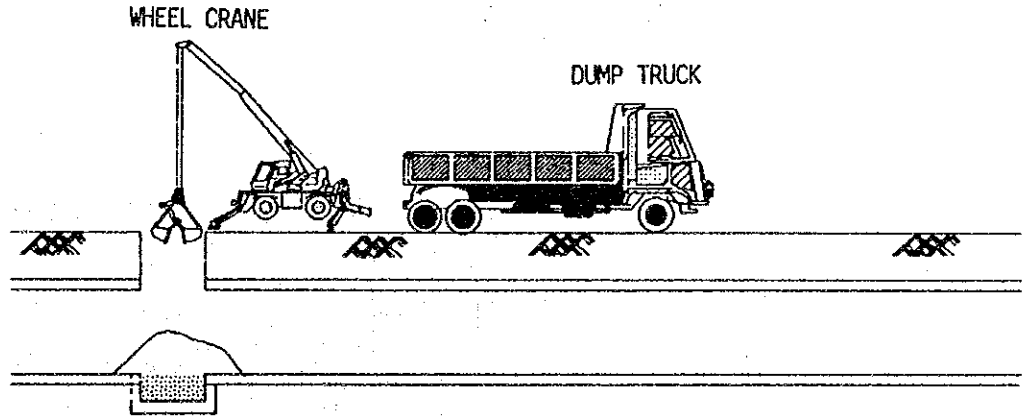
(4) Retrieval of Small Esteros

Dredging work using dredgers on the small esteros is impossible due to restricted conditions such as width, water depth and bridges. Hence, a hydraulic shovel (Backhoe) that is workable on mud surface will be employed to enhance work efficiency. Scows also cannot be utilized for the same reason, therefore, a hopper-mounted self-advancing crawler truck will be employed to facilitate the work in the esteros.

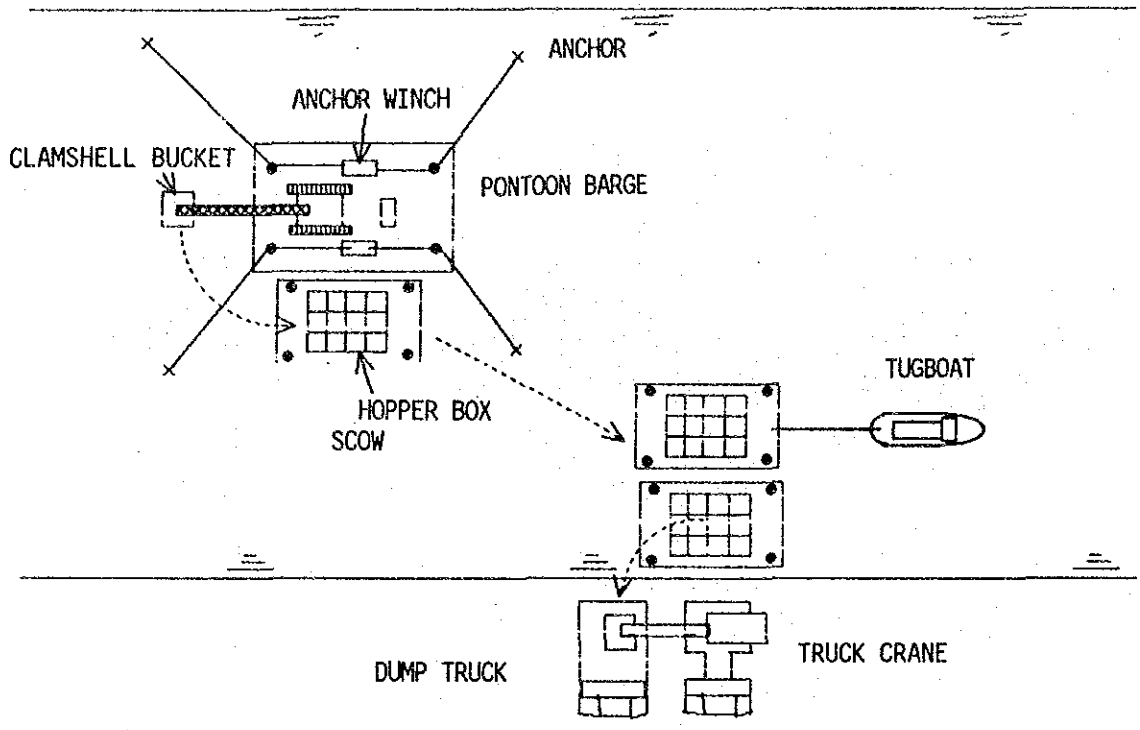


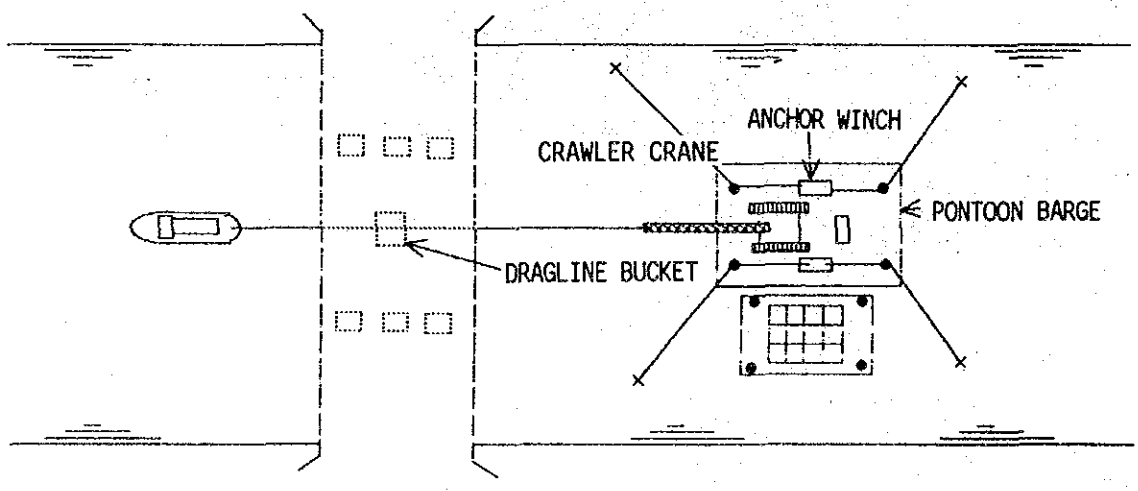
THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA (PHASE 2)	Fig. 4-1 RETRIEVAL PLAN FOR LATERAL
JAPAN INTERNATIONAL COOPERATION AGENCY	



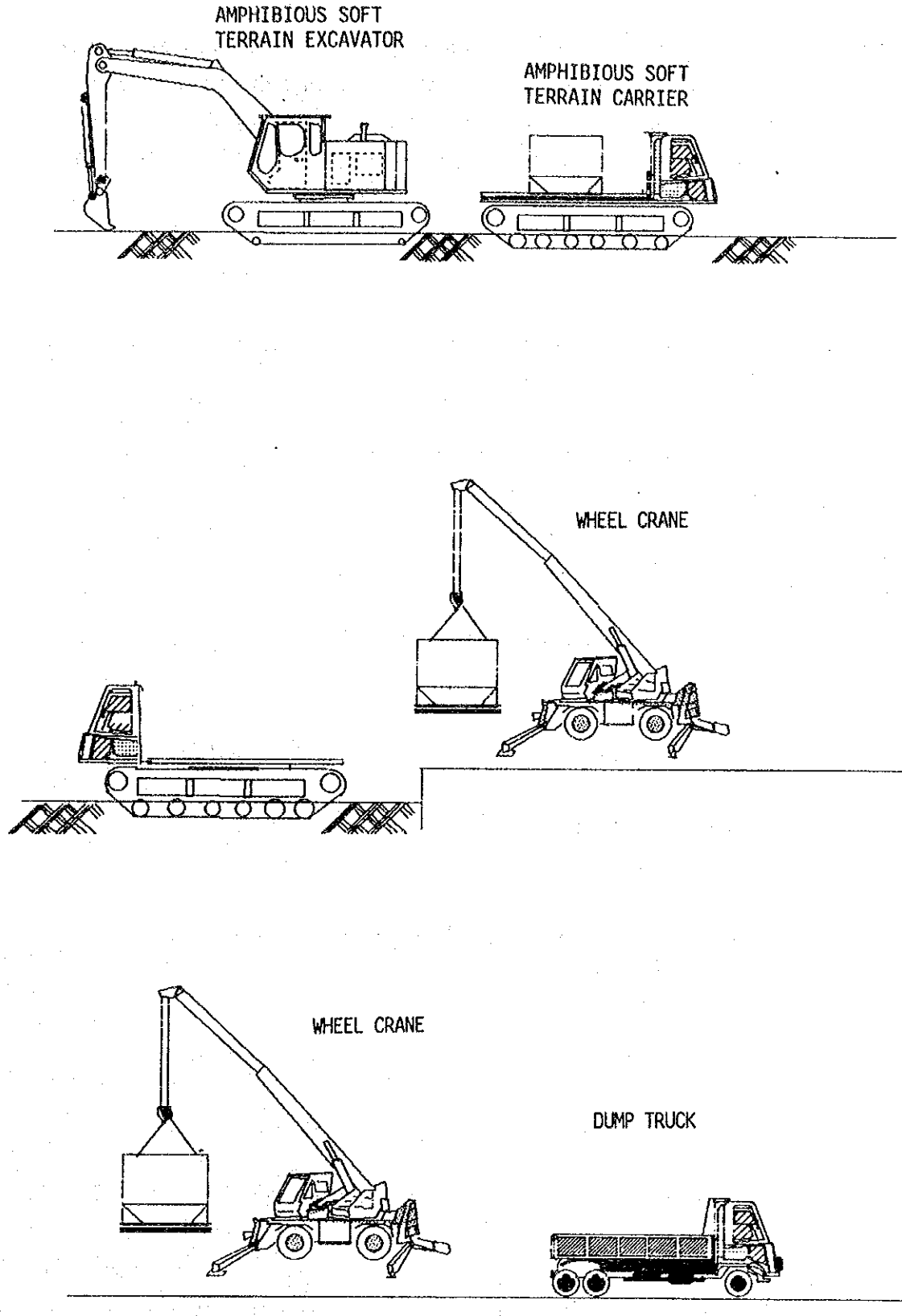


THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA (PHASE 2)	Fig. 4-2 RETRIEVAL PLAN FOR DRAINAGE MAIN AND OUTFALL
JAPAN INTERNATIONAL COOPERATION AGENCY	





THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA (PHASE 2)	Fig. 4-3 RETRIEVAL PLAN FOR LARGE ESTERO
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA (PHASE 2)	Fig. 4-4 RETRIEVAL PLAN FOR SMALL ESTERO
JAPAN INTERNATIONAL COOPERATION AGENCY	

4.3.2 List of Equipment

In accordance with the study on functions of equipment required for the proposed methods of retrieval work made in Subsection 4.3.1, the following types and quantities of equipment were selected. The details of calculation for the quantity of equipment are presented in Appendix 2.

(1) Lateral : 2 units

(a) Water Recycle Vacuum Cleaner (11-ton Truck-Mounted) : 1/unit

(b) Water Tanker (4-ton Truck-Mounted, Tank Capacity: 3.5 m^3 min.) : 1/unit

(c) Dump Truck (4-ton) : 4/unit

(d) Floodlight with Engine (Dual-light) : 1/unit

(2) Drainage Main/Outfall : 3 units

(a) Wheel Crane (with 0.6 m^3 Clamshell, 25-ton Crane) : 1/unit

(b) Dragline Equipment (0.6 m^3 Dragline Bucket, Hydraulic Winch) : 2/unit

(c) Dump Truck (4-ton) : 3/unit

(d) Truck (6-ton) : 2/unit

(e) Blower : 2/unit

(f) Generator (20 KVA) : 1/unit

(g) Floodlight (400W) : 2/unit

(h) Gas Detector (Oxygen, combustible gas, Hydrogen Sulfide) : 1/unit

(3) Large Estero : 1 unit

(a) Hydraulic Clamshell Crawler (0.6 m^3) : 1/unit

(b) Pontoon Barge (Easy Setup Type) : 1/unit

(c) Scow (Easy Setup Type, 2 m^3 Hopper x 12) : 2/unit

(d) Tugboat (60 ps) : 1/unit

(e) Hydraulic Truck Crane (25-ton Crane) : 1/unit

(f) Dump Truck (11-ton) : 3/unit

(4) Small Estero : 2 units

(a) Amphibious Soft Terrain Excavator (0.2 m^3) : 1/unit

(b) Amphibious Soft Terrain Carrier (2 m^3 Hopper x 1) : 2/unit

(c) Hydraulic Wheel Crane (20-ton Crane) : 1/unit

(d) Dump Truck (4-ton) : 5/unit

(5) Supporting Equipment

(a) Surveying Equipment (Theodolite, Electro-Optical Distance Meter)	:	1 set
(b) Walkie-Talkie (with Antenna, Microphone, Mobile Set)	:	1 set

4.3.3 Specifications of Equipment

Lateral

(1) Water Recycle Vacuum Cleaner

Vehicle	:	11-ton Truck
Max. Displacement Pressure	:	200 km/cm^2
Max. Displacement Volume	:	185 l/min
High Pressure Hose	:	min. 60 m
Sludge Tank Capacity	:	min. 3.5 m^3
Water Tank Capacity	:	min. 4 m^3
Suction Hose	:	Ø6" x 20 m
Shoot Clearance at Lifting	:	min. 2.5 m

Note: Dehydrated sediment in the tank shall be dumped into the dump truck at the jobsite.

(2) Water Tanker

Vehicle	:	4-ton Truck
Tank Capacity	:	3.5 to 4.0 m^3

Note: The water tanker shall be equipped with a pump to transfuse water to the water recycle vacuum cleaner.

(3) Dump Truck

Loading Capacity	:	min. 4 tons
Bed Capacity	:	min. 26 m^3

Note: The structure of the bed shall not leak water from the dredged sediment loaded on it. Sheet cover shall be equipped on the bed.

Drainage Main/Outfall

(1) Wheel Crane

Clamshell -

Bucket Capacity	:	0.6 m^3 and 0.3 m^3
Work Radius	:	min. 7 m
Dumping Height	:	min. 2.5 m

Crane -

Note: Installation of dragline equipment and clamshell work shall be performed by using the Wheel Crane (360° Swing)

Load x Work Radius	:	min. 25 ton x 3 m
		min. 10 ton x 8 m

(2) Dragline Equipment

Dragline Bucket	:	0.6 m^3 or 0.3 m^3
Hydraulic Winch	:	min. 5 ton x 15m/min
Wire Rope	:	20 mm
Rated Output (ps)	:	180±10/2100 rpm

(3) Truck

Loading Capacity	:	min. 6 tons
Bed Capacity	:	min. 4.2 m^3

(4) Dump Truck

Loading Capacity	:	min. 4 tons
Bed Capacity	:	min. 2.6 m^3

Note: The structure of the bed shall not leak water from the dredged sediment loaded on it. Sheet cover shall be equipped on the bed.

(5) Blower

Type	:	Outdoor, Portable
Voltage	:	240V
Phase	:	3
Capacity	:	0.3 to 0.6 KW
Fan Size	:	max. Ø300 mm
Duct	:	max. Ø300 mm x 10 m, flexible

(6) Diesel Engine Generator

Type	:	Outdoor Bonnet
Alternator -		
Frequency	:	60 Hz
Capacity	:	20 KVA
Phase	:	3
Diesel Engine -		
Type	:	Water-cooled Diesel Engine
Starting System	:	Cell Motor
Fuel	:	ASTM No. 2 Diesel Oil

(7) Gas Detector

Type	:	Portable, Simple Waterproof with Alarm Buzzer
Measuring Gas	:	Oxygen, Combustible Gas such as Methane, Hydrogen Sulfide
Temperature Range	:	0 to +40°
Sensor Cable Length	:	Approx. 5 m
Power Source	:	Dry Battery

Note: One spare sensor shall be included.

Large Estero

(1) Clamshell Crawler

Clamshell Capacity -

Bucket Capacity	:	min. 0.6 m^3
Ground Pressure	:	min. 0.55 kgf/m^2
Working Radius (Swing 360°)	:	min. 12 m
Digging Depth	:	min. 10 m
Dumping Height	:	min. 3 m

Dragline Capacity -

Bucket Capacity	:	min. 0.6 m^3
Ground Pressure	:	min. 0.55 kgf/m^2
Digging Depth	:	min. 5 m
Dumping Height	:	min. 4 m
Radius at Max. Dumping Height	:	min. 8 m

Crane Capacity (Swing 360°)

Lifting Load x Operating Radius	:	min. 30 tons x 3 m
		min. 5 tons x 10 m
Operating Weight	:	max. 35 tons
Primary Resolved Weight	:	max. 25 tons
Boom Length	:	18 m to 20 m

Note: All attachments to perform dragline, clamshell and crane shall be equipped.

(2) Pontoon Barge

Dimension -

Length	:	approx. 20 m
Breadth	:	8.0 m to 9.0 m
Depth	:	1.5 m to 1.8 m
Load Draft	:	0.8 m to 1.0 m

The barge can be broken down into 4 separate parts.

Anchor -

Weight	:	2 tons
Anchor Wire	:	200 m
Number of Installation Site	:	4

Anchor Winch (dual-drum) -

Wire Tension	:	3 tons
Wire Speed	:	15 m/min
Number of Installation Site	:	2

Submersible Pump -

Diameter	:	Ø50 mm
Pump Head	:	10 m
Number of Installation Site	:	1

Engine Generator -

Capacity	:	90 KVA
Number of Installation Site	:	1

Note: All accessories such as towing and mooring ropes and other necessary items to perform the work shall be equipped on the barge.

(3) Scow

Dimension -

Length	:	approx. 15.0 m
Breadth	:	5.0 m to 6.0 m
Depth	:	1.5 m to 1.8 m
Load Draft	:	0.8 m to 1.0 m

The scow can be broken down into 4 separate parts.

Hopper Box : 2 m^3 x 12

Note: Twelve (12) bottom-hoppers, each with capacity of 2 m^3, towing and mooring ropes shall be equipped on the scow.

(4) Tugboat

Dimension -

Length	:	approx. 9.0 m
Breadth	:	2.5 m to 3.0 m
Depth	:	1.2 m to 1.5 m
Load Draft	:	0.8 m to 1.0 m
Main Prime Mover	:	60 ps
Anchor Winch	:	1
Anchor Roller	:	1
Navigation Light	:	2

Note: Other necessary items including towing ropes to perform the work shall be equipped on the boat.

(5) Hydraulic Wheel Crane

Crane Capacity -

Lifting Load x Operating Radius	:	min. 25 tons x 3 m
		min. 4.5 tons x 12 m
Boom Type	:	Telescopic

Boom Length -

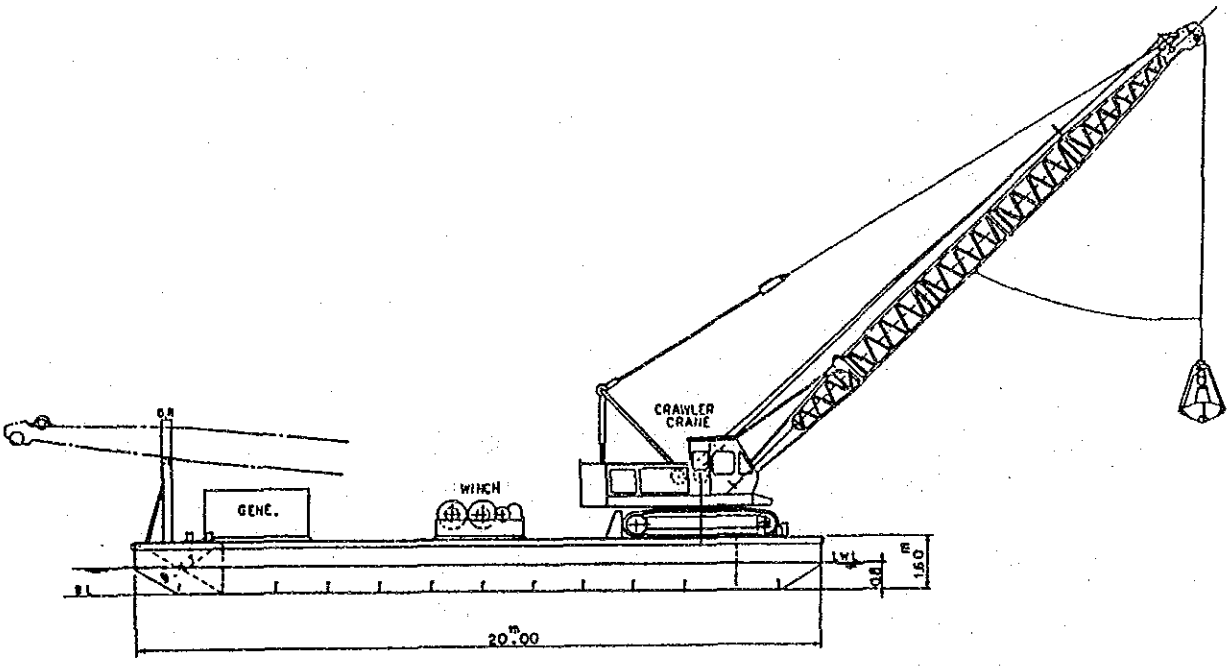
Basic	:	10 to 11 m
Maximum (5-step)	:	24 to 25 m

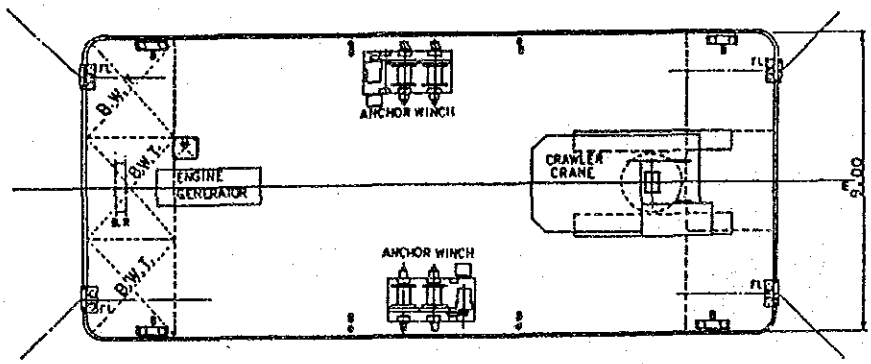
Note: Winches to open/close hoppers, each with capacity of 2 m^3, and other necessary items such as hooks to perform the work shall be equipped on the crane.

(6) Dump Truck

Loading Capacity	:	min. 11 tons
Bed Capacity	:	min. 6.5 m^3

Note: The structure of the bed shall not leak water from the dredged sediment loaded on it. Sheet cover shall be equipped on the bed.



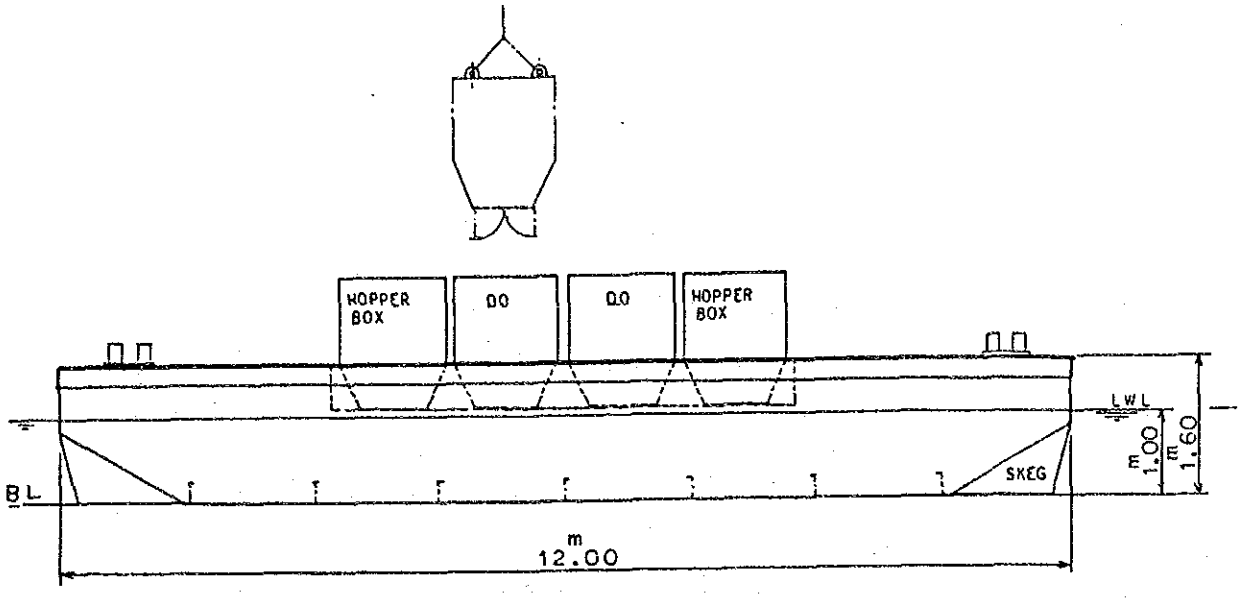


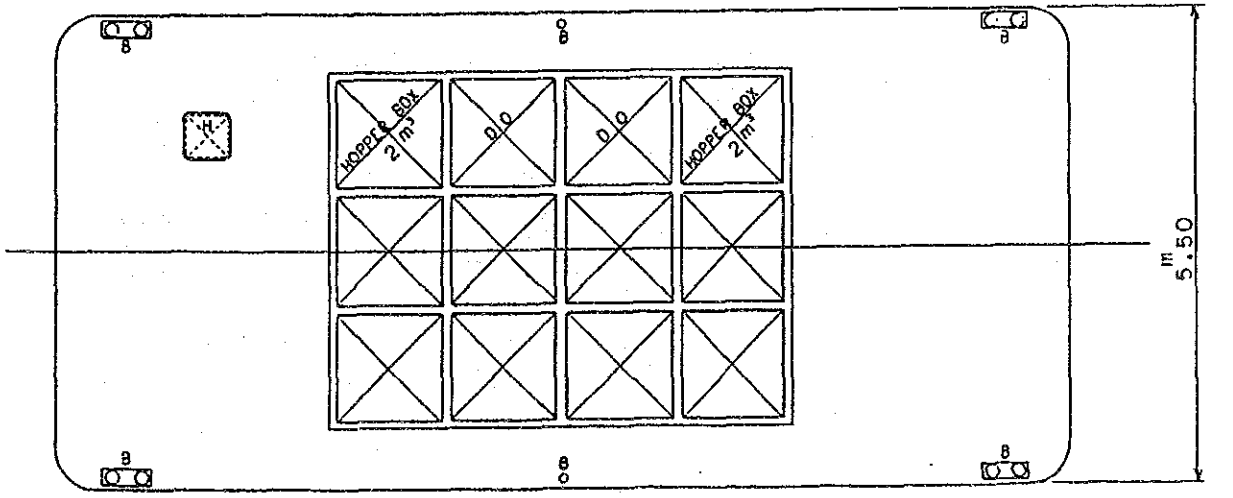
DIMENSIONS		
LENGTH		20.00 m
BREADTH		9.00 m
DEPTH		1.60 m
LOAD. DRAFT	abt	0.80 m

THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA (PHASE 2)

JAPAN INTERNATIONAL COOPERATION AGENCY

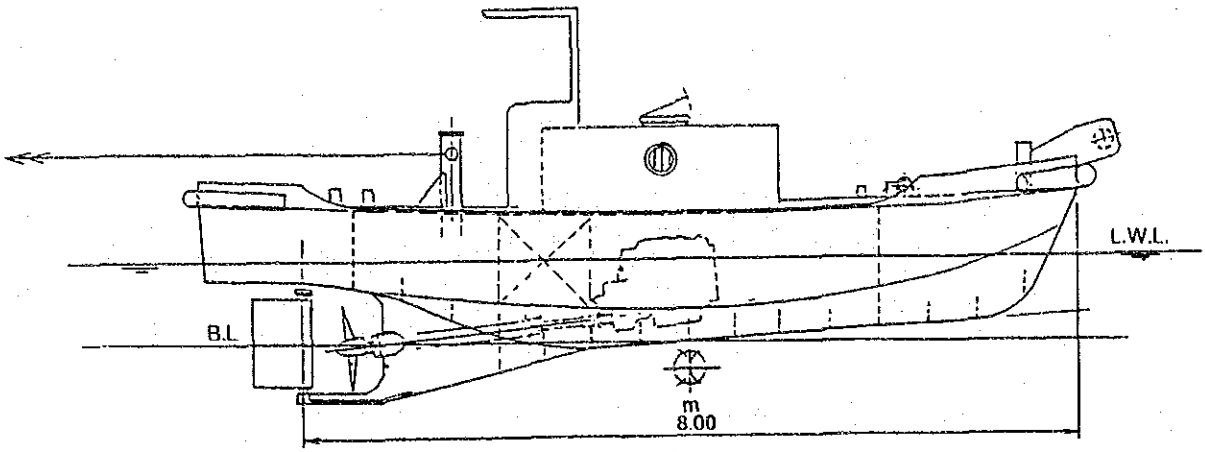
Fig. 4-5 STANDARD TYPE OF DREDGER FOR LARGE ESTERO

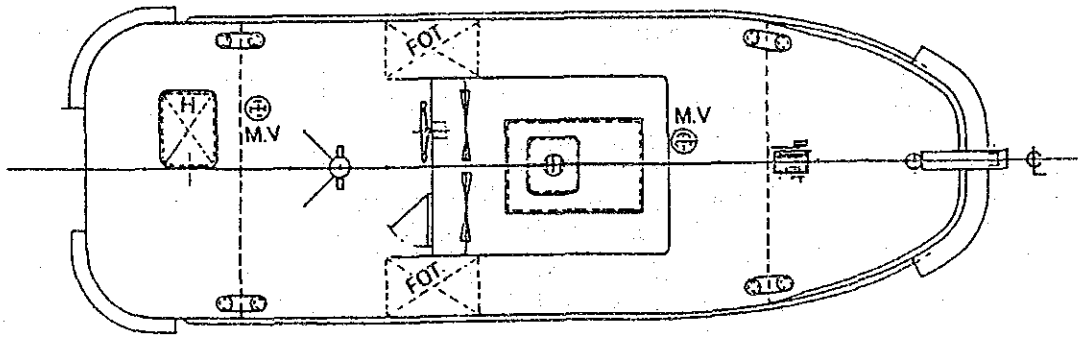




DIMENSIONS	
LENGTH	12.00 m
BREADTH	5.50 m
DEPTH	1.60 m
LOAD.DRAFT abt	1.00 m
HOPPER BOX (2m³)	12 PC

THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA (PHASE 2)	Fig. 4-6 STANDARD TYPE OF SCOW FOR LARGE ESTERO
JAPAN INTERNATIONAL COOPERATION AGENCY	





DIMENSIONS	
LENGTH	9.00 m
LENGTH (P.P)	8.00 m
BREADTH	2.80 m
DEPTH	1.20 m
LOAD. DRAFT abt	0.80 m
HOPPER BOX ($2m^3$)	60 PC

THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA (PHASE 2)	Fig. 4-7 STANDARD TYPE OF TUGBOAT
JAPAN INTERNATIONAL COOPERATION AGENCY	

Small Estero

(1) Amphibious Soft Terrain Excavator

Backhoe Capacity -

Bucket Capacity	:	0.2 m^3
Ground Pressure	:	max. 0.11 kgf/m^2
Cutting Radius	:	min. 5 m
Digging Depth	:	min. 2.5 m
Dumping Height	:	min. 2.5 m
Radius at Max. Dumping Height	:	min. 3 m
Operating Weight	:	max. 10 tons
Resolved Weight at Transportation	:	max. 11 tons
Dimension at Transportation -		
- Overall Length	:	max. 5.5 m
- Overall Width	:	max. 3.4 m

Note: The structure of the Shovel shall allow travelling and dredging work on mud surface. All necessary items to perform the dredging work shall be equipped on the hydraulic shovel.

(2) Ampbibious Soft Terrain Carrier

Hopper	:	2 m^3 x 1
Operating Weight	:	max. 10 tons
Resolved Weight at Transportation	:	max. 11 tons
Dimension at Transportation -		
Overall Length	:	max. 5.5 m
Overall Width	:	max. 3.4 m

Note: The structure of the hopper shall allow travelling on mud surface. One bottom-hopper with capacity of 2 m^3 shall be equipped on the crawler truck.

(3) Hydraulic Wheel Crane

Crane Capacity (Outrigger Fully Extended, 360° Swing) -

Lifting Load x Operating Radius	:	min. 25 tons x 3 m
		min. 4.5 tons x 12 m
Boom Type	:	Telescopic
Boom Length -		
Basic	:	10 to 11 m
Maximum (5-step)	:	24 to 25 m

Note: Winches to open/close hoppers, each with capacity of 2 m^3, and other necessary items including hooks shall be equipped on the hydraulic wheel crane.

(4) Dump Truck

Loading Capacity	:	min. 4 tons
Bed Capacity	:	min. 2.6 m^3

Note: The structure of the bed shall not leak water from the dredged sediment loaded on it. Sheet cover shall be equipped on the bed.

Supporting Equipment

(1) Surveying Equipment

(a)	Theodolite, with Tripod; min. reading unit of 20 sec.	:	3
(b)	Automatic Level, with Tripod; Telescope of 30 magnifications	:	3
(c)	Echo Sounder, Precision: ±2 cm ± water depth x 1/1,000	:	3
(d)	Electro-Optical Distance Meter, with a set of prisms; distance range of 800 m	:	3
(e)	Tide Gauge, long-term recording type gauge	:	1

(2) Walkie-Talkie:

Base Set, with Antenna, Microphone	:	135 - 174 MHz
Mobile Set	:	135 - 174 MHz (VHF)

4.3.4 Model Implementation of Retrieval Work

(1) Aim of Model Implementation

The proposed retrieval work for the existing drainage channels and drains will include various types of work in the laterals, drainage mains and outfalls, and will require a rather big organization for simultaneous operation of the various types of equipment. In addition to this, as work methods will be selected taking into account the conditions in the Philippines, equipment that is slightly different from that used in Phase 1 will be selected, requiring sophisticated technical skill in the operation of the water recycle vacuum cleaner, dredging work in the esteros as well as disassembly/assembly of easy-setup type dredgers.

The Government of Philippines has inadequate knowledge regarding the supervision as well as operation and maintenance of the equipment to be procured under the project. Hence, in order to maximize the work efficiency of equipment and avoid accidents that might occur during operation, it has been decided to carry out actual retrieval work in a model area, as a part of the project with the aim of transferring knowledge concerning operation and maintenance.

The model area has been selected as the area most urgently requiring retrieval of the existing drainage channels and drains and which will contribute to the immediate reduction of flood damage. Flood damage reduction is also aimed at by the model implementation, together with the transfer of technical knowledge.

(2) Preconditions of Model Operation

All the equipment will be used in the model implementation area. Retrieval work will be executed by a Japanese contractor and supervised by a Japanese consultant who have sufficient experience in carrying out the same type of work as that to be implemented under the project.

Technical knowledge will be transferred to the selected personnel listed below from organizations under the National Capital Region (NCR).

(a)	Flood Control and Water Supply Section, Maintenance Division, NCR	:	145 engineers
(b)	NCR North Manila Engineering District	:	24 engineers
(c)	NCR South Manila Engineering District	:	44 engineers
(d)	NCR Regional Equipment Service	:	125 engineers

(3) Term of Model Implementation

Working conditions for the retrieval of drainage channels and drains vary greatly between the rainy season and the dry season. During the rainy season, which usually continues from June to November, increased water in drainage channels and drains will hamper the work and cause long work interruptions. During the dry season, on the other hand, working conditions are better and the work efficiency of equipment is expected to increase. To minimize the decrease of work efficiency in the rainy season and to maximize the efficiency in the dry season, the appropriate operation and control of selected equipment will need to be carried out both in the rainy and dry season. Special regard will need to be paid to the limited work schedule.

The model implementation includes the installation, adjustment, trial operation of the equipment, guidance lecture, and dredging and

declogging work. The total implementation period is estimated to be 6.0 months, of which, dredging/declogging work will presumably require approximately 2.5 months commencing in mid-December in view of the standard work volume per day and the work volume in the designed area.

(4) Standard Work Volume of Model Implementation

The standard work volume per day is calculated as follows on the basis of the total number of work days for 2.5 years (see Subsection 4.2.2) and its corresponding total work volume.

Work Item	Total Work Days	Total Work Volume (m^3)	Standard Work Volume (m^3 per day)
Retrieval of Lateral	575	18,933	32.9
Retrieval of Drainage Main/Outfall with Concrete Maintenance Hole	575	38,055	66.2
Retrieval of Large Estero	575	35,800	62.2
Retrieval of Small Estero	575	42,300	73.5

The standard work volume of the model implementation is then calculated as follows on the basis of the term of the model implementation and the above standard work volume per day.

Work Item	Season	Workable Days	Standard Work Volume
Retrieval of Lateral	2.5 month/Dry	60	1,974 m^3
Retrieval of Main/ Outfall (with concrete maintenance hole)	2.5 month/Dry	60	3,972 m^3
Retrieval of Large Estero	2.5 month/Dry	60	3,732 m^3
Retrieval of Small Estero	2.5 month/Dry	60	4,410 m^3

(5) Sites and Work Volume of Model Implementation

The sites for model implementation were arranged to be (1) the areas susceptible to floods, (2) the areas where the effect of model implementation will be possible to confirm and evaluation will be easily obtained from residents, and (3) the areas where traffic control is relatively easy. The sites were selected on the basis of the standard model work volume shown above. From these considerations, the following were decided as the sites of the model implementation.

Retrieval of Lateral (Laterals in Pasay City and Makati)

Name of Street	Length (m)	Work Volume (m^3)
Pasay Road	8,640	1,192
Taft Avenue	3,607	527
Pasong Tamo	3,730	397
Total	15,977	2,116

Retrieval of Drainage Main/Outfall (with Concrete Maintenance Hole) : Makati Headrace (Length: 1,100 m)

: Pasong Tamo (Length: 550 m)

Retrieval of Large Estero : Parañaque River (Length: 180 m)

Retrieval of Small Estero : Tripa de Gallina (The junction and surrounding area of Tripa de Gallina and Dilain Creek)

The sites of the model implementation and their drainage areas are as shown in Fig. 4-8. By using all equipment to be supplied on these stretches during the term of the model implementation, the actual work

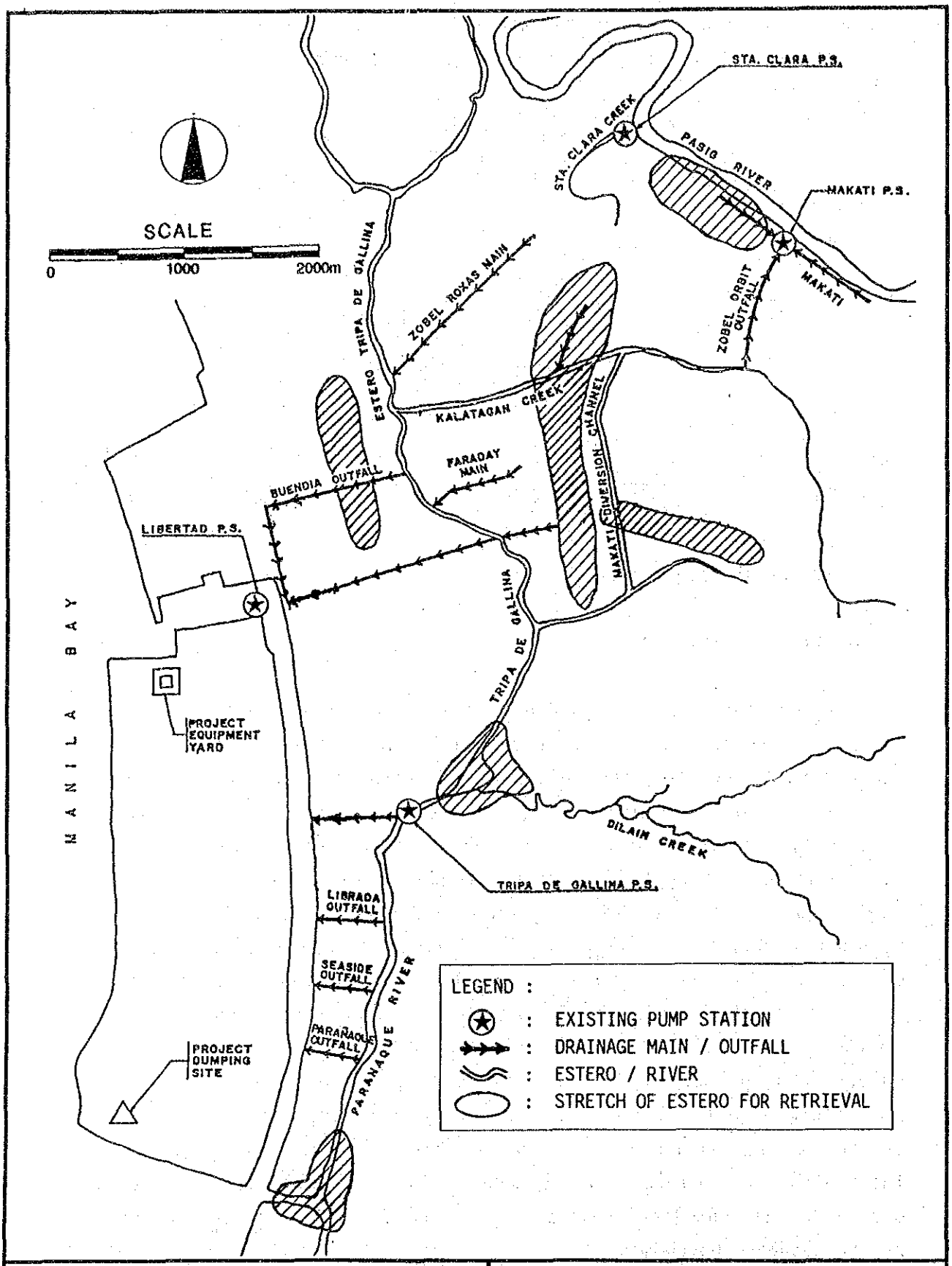
volume to be achieved by the model implementation will amount to approximately 10% of the total work volume, as shown below.

Work Item	Work Volume Achieved by Model Implementation (m^3) (1)	Total Work Volume (2)	(1)/(2) (%)
Laterals	2,116	18,933	11.2
Drainages Mains/ Outfalls, Makati	1,580 (Makati Headrace)		
	2,440 (Pasong Tamo)		
	4,020 (Total)	38,055	10.5
Large Esteros	3,590	35,800	10.0
Small Esteros	4,223	42,300	10.0

4.4 Implementation Plan

4.4.1 Implementation Policy

After concluding the Exchange of Notes (E/N) between the Japanese Government and the Government of the Philippines, the latter is to sign the contract regarding the design and construction supervision with a consultant registered with a Japanese corporate body. After verification of the contract by the Japanese Government, implementation will commence. Detailed design and tender documents will be drawn up after conducting site investigations and work in Japan. The tender documents, upon approval by the Government of the Philippines (the owner), will be used by the tender to select contractors who will contract for this project. In conformance with the Japanese grant aid system, open tender will be conducted for Japanese contractors who successfully passed the pre-qualification. If the tender is confirmed to conform with the aim and intention of the owner, the contractor who presented the minimum price will be regarded as the successful tenderer. The contractor contract is to be made in the presence of the consultant, and, like the consultant contract, is to come into effect upon approval by the Japanese Government.



THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA (PHASE 2)	Fig. 4-8 STRETCH FOR MODEL IMPLEMENTATION OF RETRIEVAL WORK
JAPAN INTERNATIONAL COOPERATION AGENCY	

4.4.2 Implementation Method

Items to be implemented under the project can be divided into procurement of the equipment and the on-site model implementation. Equipment to be procured includes large construction machinery and customized vehicles requiring special orders. A period of 4 to 6 months will be necessary from the time the order is made to the time of delivery in Manila. The time required for procurement will vary according to the type of equipment, and since the model implementation using the equipment procured will be greatly affected by the weather conditions in the rainy season, delay in the arrival of the equipment in Manila may precipitate alterations to the schedule of the model implementation. In this connection, a rational plan for project implementation has to be established by carrying out an adequate adjustment between the term for procurement and that of the model implementation.

Various types of work using large construction machinery will be integrated with each other in the model implementation, requiring careful schedule control and adequate safety measures. There is also the possibility that problems such as generation of foul odors and noise will occur during the deposit removal work and transportation of the deposits removed to dumping sites. On-site supervisors will be required to take appropriate actions concerning these environmental problems.

The aim of the model implementation is not merely to achieve the targets that have been set but also to effect transfer to the Philippine governmental agencies of technology associated with the management and operation, as well as maintenance of the equipment. There is then a need to maintain close contact with the Philippine governmental agencies to achieve this end.

4.4.3 Construction and Supervisory Plan

In accordance with the contract, the consultant will invite bids on behalf of the Department of Public Works and Highways (DPWH). During the term of on-site model implementation, the consultant will also send

to the site a permanent supervisor, who is well acquainted with the details of the project and has adequate technical expertise to give directions and carry out adjustments of the work and who will work for the transfer of technology involved in the operation.

4.4.4 Procurement Plan

Equipment required under the project is not manufactured in the Philippines and will have to be imported from abroad. Equipment to be procured consists of rather sophisticated machinery (water recycle vacuum cleaners, amphibious soft terrain excavators), dredging vessels and dump trucks, and the number of these types of equipment will add up to over 60. The model implementation using all these types of equipment needs to be quickly implemented soon after the arrival of shipment in Manila and delays in arrival may greatly affect the schedule of the model implementation as a whole. It will not be appropriate to supply the equipment by partial shipments and it is, therefore, not desirable to procure equipment from both Japan and third countries.

Construction machinery in use in the Philippines at present includes, besides Japanese products, those produced in the United States of America and Europe. There is little difference in the prices of these machines, however, and Japanese products being the most commonly used, it will be most advantageous to use Japanese products for the project when considerations are made for future repairs and maintenance. There has been no specific request from the Government of the Philippines for procurement of equipment from a third country.

In view of the above, all equipment will be produced and tested in Japan, exported to the Philippines by sea and, after landing in the Philippines, be delivered to the equipment storehouse of the DPWH at Libertad in Pasay City, Metro Manila.

4.4.5 Implementation Schedule

It will take approximately twelve (12) months for the project implementation. With regard to the work items covered by the Japanese Government, a contract for detailed design (D/D) is to be signed by the

Government of the Republic of the Philippines and a consulting firm as soon as the Exchange of Notes has been concluded. The detailed design will require two (2) months and tender is scheduled to be opened within one (1) month afterward.

After signing the contract with the successful tenderer, orders will be made with machinery manufacturers for special vehicles and dredging vessels. The procurement of equipment and model implementation will take 5.5 months and 6.0 months, respectively (See Table 4-3).

4.4.6 Scope of Work

In implementing the project, the work items to be covered by both the Japanese Government and the Government of the Philippines in conformance with the Grant Aid will be as follows:

Work Items to be covered by the Government of Japan:

(1) Procurement of Equipment

(2) Equipment Transportation by Sea

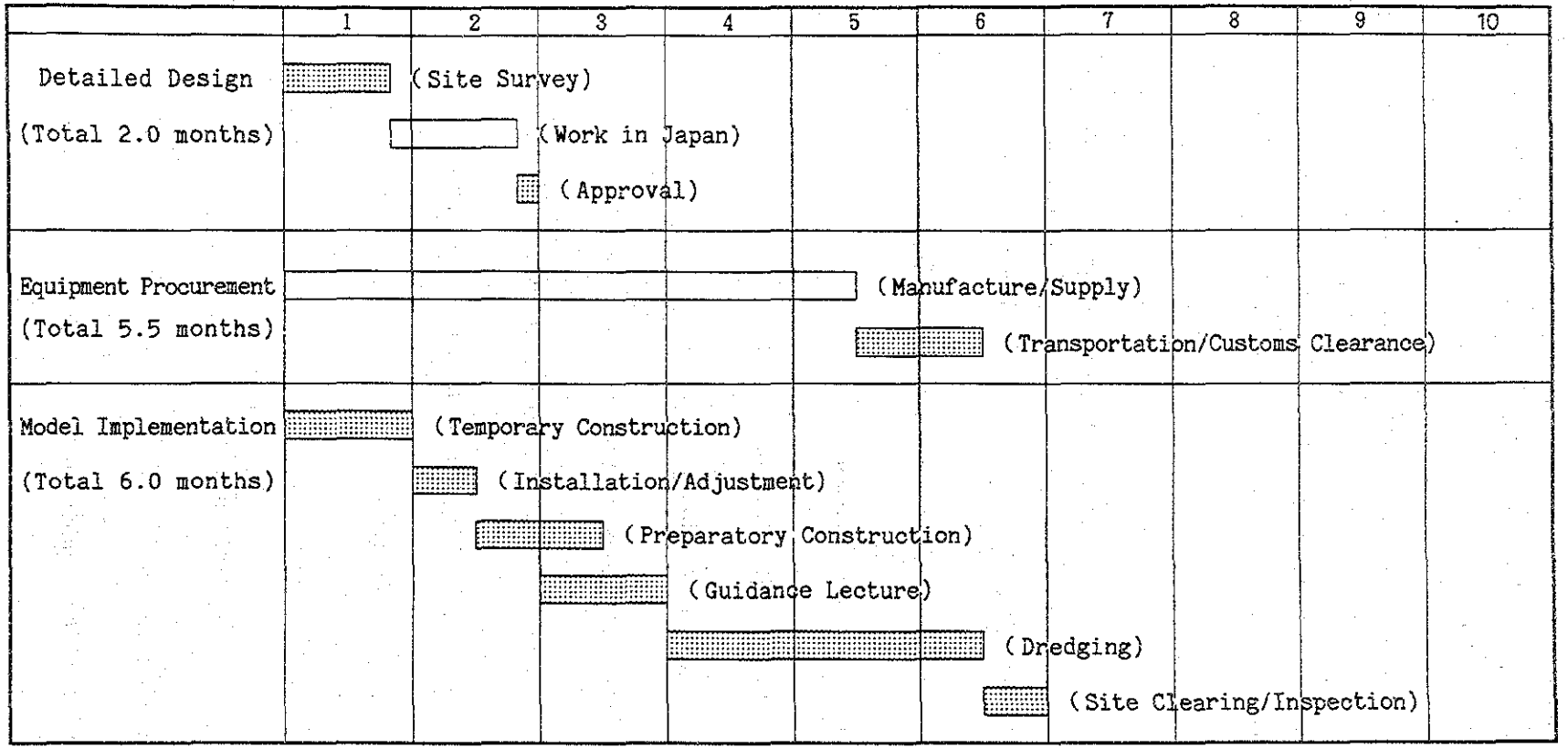
(3) Model Implementation

- Temporary Construction
- Equipment Installation/Adjustment
- Preparatory Construction/Trial Operation
- Guidance Lecture
- Dredging Work
- Site Clearing/Inspection

(4) Detailed Design

(5) Construction Supervision

Table 4-3 Implementation Schedule



Work Items to be covered by the Government of the Philippines:

(1)	To prepare the project dumping site	(Estimated Cost: 4.5 million pesos)
(2)	To prepare the storehouses for project equipment	(Estimated Cost: 3.0 million pesos)
(3)	To bear the commissions of the Japanese foreign exchange bank for banking services	(Cost subject to bank arrangement)
(3)	To arrange tax exemption and customs clearance of equipment at the port of disembarkation	(Cost subject to Customs regulation)

CHAPTER 5. PROJECT EVALUATION AND CONCLUSION

5.1 Impact of the Project

The project area, which is about 60 km^2, consists of Pasay City, Makati and part of Parañaque in Metro Manila. The population benefiting directly from the project is estimated at 3.3 million.

The population of the project area has been expanding rapidly in recent years. In keeping pace with the explosive increase in population, an increasing number of people have suffered from floods during rainy season, which occur almost every year. This project has been organized as part of an infrastructure development project aimed at tackling these problems confronting Metro Manila, and its early implementation is being sought. Improvement of existing drainage channels in and around the city of Manila has already been under way for some time in the form of grant aid cooperation from Japan. The economic and social effects of the project have proved to be great, and are rated highly by the Government of the Philippines.

The expected effects of this project and degrees of improvement are shown on page 86.

5.2 Conclusion

The people benefiting from this project are mainly residents of low-lying areas. Many of them are poor people whose number is increasing rapidly under the influence of accelerated urbanization. This grant-aid project is significant since it is expected to reduce flood damage afflicting the people and contribute to the improvement and stabilization of their living environment. The Department of Public Works and Highways (DPWH) of the Government of the Philippines indicated that it could divert part of the funds for the Annual Infrastructure Program to the operation and maintenance of the facilities to be built under this project. The office of DPWH's National Capital Region (NCR) has already secured the personnel required for the operation and

maintenance. It can be concluded, therefore, that the recipient country has made adequate preparations for the implementation of the project.

It is necessary, however, for the Government of the Philippines to take proper steps to prevent illegal dumping of garbage into drains (e.g., education of residents concerning the need to clean up drains, improvement of refuse collection systems) in order to make the improvement of existing drains under this project more effective. To this end, it is important for the implementing bodies of this project, DPWH and NCR, to see to it that effective measures are planned and implemented through harmonious cooperation and coordination with the other agencies concerned (Metropolitan Manila Authority, municipal governments, etc.).

It is desirable that the agencies concerned should plan the development and maintenance of dumping sites from the viewpoint of long-term effect and implement them systematically so that the environment will not be adversely affected.

In other areas in Metro Manila as well as local cities which are undergoing rapid urbanization, there is a pressing need for the improvement of municipal drainage systems. It can reasonably be expected that cities other than Manila will also need similar projects for improving drainage facilities. It is strongly recommended, therefore, that the Government of the Philippines aim to develop the appropriate methodology for drainage system improvement and implement it throughout the country.

	Present State and Problems	Planned Measures	Expected Effects and Improvements
1.	Existing drains in Metro Manila are said to be able to withstand 10-year floods. In reality, however, sediments blocking the drains often cause flooding, thus posing a serious problem.	Prepare equipment needed to improve existing drains in order to improve the efficiency of sediment removal.	The flood discharge capacity will be increased and flood damage will be reduced accordingly. Flood damage to about 600,000 houses will be prevented. The decrease in flood damage is expected to amount to around 2.8 million pesos.
2.	Sediments in the drains contain large quantities of garbage, which often cause odor and infectious diseases.	- ditto -	The removal of sediment is expected to improve the living environment of local residents, raise the level of awareness of the need for sanitation, and help decrease epidemics of infectious diseases.
3.	Every year stormwater floods occur over a long period of time, causing traffic congestion in Metro Manila and hampering economic activities in urban areas.	- ditto -	The improvement of drains is expected to help ease traffic congestion, thereby stimulating economy and restoring city functions.
4.	Improvement of existing drains now depends mostly on manual labor because of lack of equipment. Work efficiency is extremely low, and the progress of work is frustratingly slow.	- ditto -	Personnel necessary for machine operation will be secured. The introduction of machinery will increase efficiency and safety and enable the execution of difficult work that cannot be done manually. The deadlines for work can be met and the progress of work can be controlled as scheduled.
5.	Technical standards for the operation, maintenance and management of machinery are low.	Execute model work with the aim of technology transfer.	Technical standards can be raised, and machinery can be utilized over long periods of time.